Chapter: 19

State(s): Idaho

Recovery Unit Name: Little Lost River

Region 1
U.S. Fish and Wildlife Service
Portland, Oregon

DISCLAIMER

Recovery plans delineate reasonable actions that are believed necessary to recover and/or protect listed species. Recovery plans are prepared by the U.S. Fish and Wildlife Service and, in this case, with the assistance of recovery unit teams, State and Tribal agencies, and others. Objectives will be attained and any necessary funds made available subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Recovery plans do not necessarily represent the views or the official positions or indicate the approval of any individuals or agencies involved in the plan formulation, other than the U.S. Fish and Wildlife Service. Recovery plans represent the official position of the U.S. Fish and Wildlife Service *only* after they have been signed by the Director or Regional Director as *approved*. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery tasks.

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EXECUTIVE SUMMARY

CURRENT SPECIES STATUS

The U.S. Fish and Wildlife Service issued a final rule listing the Columbia River population of bull trout (*Salvelinus confluentus*) as a threatened species under the Endangered Species Act on June 10, 1998 (63 FR 31647). The Little Lost River Recovery Unit forms part of the range of the Columbia River distinct population segment. The Little Lost River Recovery Unit consists of a single core area, including the mainstem river and tributaries in which bull trout have been observed. The core area includes 10 local populations.

HABITAT REQUIREMENTS AND LIMITING FACTORS

A detailed discussion of bull trout biology and habitat requirements is provided in Chapter 1 of this recovery plan. The limiting factors discussed here are specific to the Little Lost Recovery Unit chapter. Within the Little Lost River Recovery Unit, elevated stream temperatures are probably the most limiting factor for bull trout (LLRITAT 1998). Land management activities— such as water diversions and improper grazing practices—that degrade aquatic and riparian habitats by altering stream flows and riparian vegetation may elicit or exacerbate unsuitable water temperature regimes for bull trout. Other factors that negatively affect bull trout in the Little Lost River Recovery Unit include habitat fragmentation and isolation due to fish passage barriers, interactions with nonnative brook trout, and possibly harvest of fish due to poaching or to misidentification by anglers.

RECOVERY GOALS AND OBJECTIVES

The goal of the bull trout recovery plan is to **ensure the long-term persistence of self-sustaining, complex, interacting groups of bull trout distributed throughout the species' native range so that the species can be delisted.** To achieve this goal, the following objectives have been identified for bull trout in the Little Lost River Recovery Unit:

- Maintain current distribution of bull trout and restore distribution in previously occupied areas within the Little Lost River Recovery Unit.

- Maintain stable or increasing trends in abundance of bull trout in the Little Lost River Recovery Unit.

- Restore and maintain suitable habitat conditions for all bull trout life history stages and strategies.

- Conserve genetic diversity and provide opportunity for genetic exchange.

RECOVERY CRITERIA

Recovery criteria for the Little Lost River Recovery Unit are established to assess whether actions are resulting in the recovery of bull trout in the basin. The criteria developed for bull trout recovery address quantitative measurements of bull trout distribution and population characteristics on a recovery unit basis.

The recovery unit team also developed an approach to generate potential recovery tasks. The approach included describing local populations and areas important for bull trout; determining whether local populations and areas were attaining their recovery potential; identifying protective actions for some areas to ensure that they continued toward recovery and identifying reasons why other areas were not attaining their potential; and developing actions to address the factors inhibiting recovery. The approach generated information that contributed to developing recovery criteria for the Little Lost River Recovery Unit.

1. **Distribution criteria will be met when the current distribution of bull trout in the 10 local populations that have been identified is maintained.** Existing local populations include Badger Creek, Williams Creek, Wet Creek (including Big Creek), Warm Creek, Squaw Creek, Mill Creek, Iron Creek (including Hawley and Jackson Creeks), Timber Creek (including Camp, Redrock, and Slide Creeks), Smithie Fork Creek, and the upper Little Lost River (Iron Creek confluence to headwaters,

excluding the Timber Creek and Smithie Fork Creek watersheds). The recovered distribution of bull trout in the Wet Creek local population requires fish in Big Creek, a tributary to Wet Creek.

2. **Abundance criteria will be met when the estimated abundance of adult bull trout is at least 6,750 individuals in the Little Lost River Recovery Unit.** Using professional judgment, the Little Lost River Recovery Unit Team estimated abundance of adult bull trout for the recovery unit by using surveys of fish densities and considering current habitat conditions and potential conditions after threats have been addressed. Because most bull trout in the recovery unit are resident fish, fish that are 180 millimeters (7.1 inches) or longer were considered adults. Minimum abundance of adult bull trout estimated for local populations to meet abundance criteria are presented in Appendix C.

3. **Trend criteria will be met when adult bull trout exhibit stable or increasing trends in abundance, over at least two generations, in the Little Lost River Recovery Unit.**

4. **Connectivity criteria will be met when specific barriers to bull trout migration in the Little Lost River Recovery Unit have been addressed.** Tasks to identify and assess barriers to bull trout passage are recommended in this recovery plan. Sites and activities necessary to fulfill connectivity criteria include the following: evaluating passage options at the diversion structures in the lower reaches of Badger and Williams Creeks (tasks 1.2.1, 1.2.2, and 1.2.3), at the falls created by debris and perhaps a head-cut in Bunting Creek (task 1.2.13), and at the flood-control structure near Howe (task 1.2.11); implementing appropriate actions based on the results of the options evaluated in the tasks (tasks appear in the Recovery Measures Narrative and the Implementation Schedule); and conducting coordinated review with the U.S. Fish and Wildlife Service during implementation of the tasks.

ACTIONS NEEDED

Recovery for bull trout in the Little Lost River Recovery Unit will entail reducing threats to the long-term persistence of populations and their habitats, ensuring the security of multiple interacting groups of bull trout, and providing habitat and access to conditions that allow for the expression of various life history forms. The seven categories of actions needed are discussed in Chapter 1; tasks specific to this recovery unit are provided in this chapter.

ESTIMATED COST OF RECOVERY

The estimated cost of bull trout recovery in the Little Lost River Recovery Unit is $1 million spread over a 25-year period. This estimate does not include costs associated with some activities (*e.g.*, capital improvements for fish passage and protection) for which the feasibility and design options are the outcomes of recommended tasks in this chapter, nor does this estimate include costs of tasks that are normal agency responsibilities under existing authorities. Total costs include estimates of expenditures for local, Tribal, State, and Federal govenments and private business and individuals. These costs are attributed to bull trout conservation, but other aquatic species will also benefit.

ESTIMATED DATE OF RECOVERY

Time required to achieve recovery depends on bull trout status, factors affecting bull trout, implementation and effectiveness of recovery tasks, and responses to recovery tasks. A tremendous amount of work will be required to restore impaired habitat, reconnect habitat, and eliminate threats from nonnative species. If actions specifically identified in this chapter are implemented, as well as the actions that are generated from conducting the specific evaluations and assessments described in this chapter, the Little Lost River Recovery Unit Team anticipates that recovery could be achieved in two to five bull trout generations (10 to 25 years).

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INTRODUCTION

Recovery Unit Designation

The Little Lost River Recovery Unit is one of 22 recovery units designated for bull trout in the Columbia River basin (Figure 1). The Little Lost River basin was designated a bull trout recovery unit because it is naturally isolated: bull trout habitats in the basin have not been directly connected to habitats in other basins for several thousand years. Bull trout in the basin consist of the only population upstream of Shoshone Falls, a major migration barrier on the Snake River near the City of Twin Falls, Idaho. The Little Lost River basin was also identified as a bull trout key watershed in the Idaho Bull Trout Conservation Plan (Batt 1996; Little Lost River Interagency Technical Advisory Team (LLRITAT) 1998).

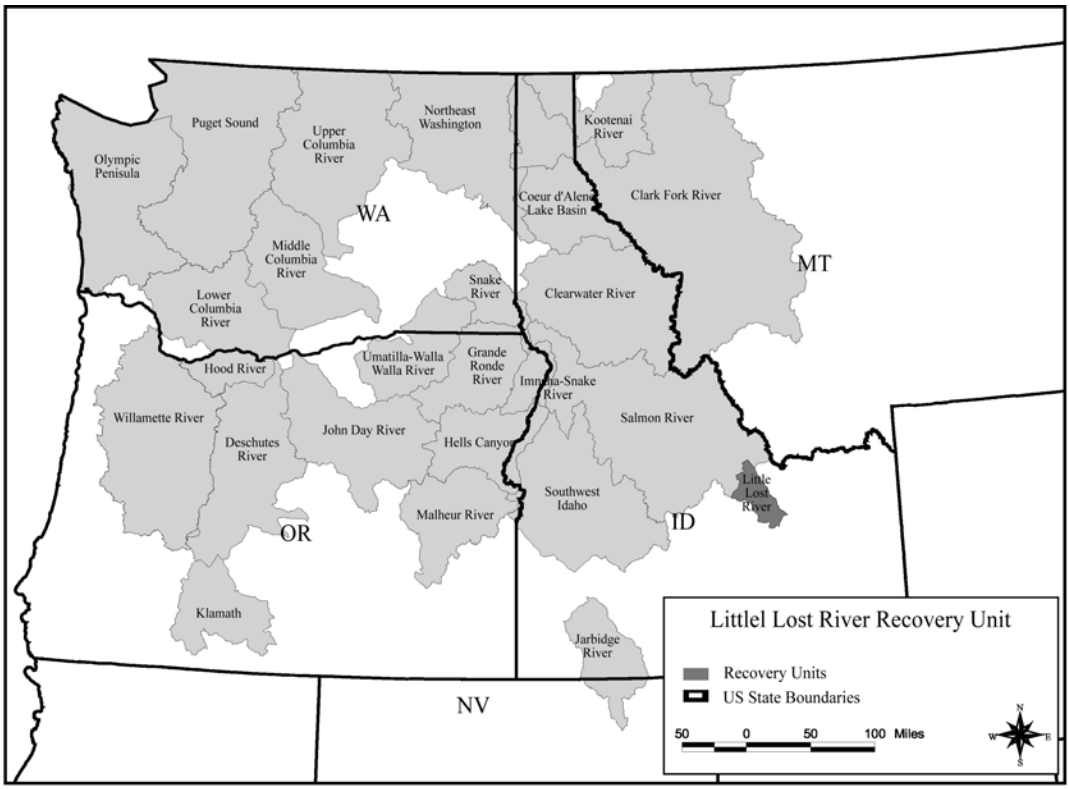
Geographic Description

The Little Lost River lies in a closed basin within the upper Snake River basin. The Little Lost River Recovery Unit encompasses an area of 252,003 hectares (973 square miles) in portions of Butte, Custer, and Lemhi Counties, Idaho (Gamett 1999). Elevations in the basin range from 1,456 meters (4,778 feet) at the Little Lost River Sinks to 3,718 meters (12,201 feet) at the summit of Diamond Peak in the Lemhi Mountains. The river flows southeastward between the Lost River and Lemhi Mountain ranges.

Waters of the Little Lost River Recovery Unit historically flowed into the upper Snake River (*i.e.*, upstream of Shoshone Falls). Because of volcanic eruptions during the Pleistocene epoch, river flow becomes subterranean in the "sinks" area of the Snake River plain. Therefore, the Little Lost River has no surface flow to the Snake River (Gamett 1999). Fish fauna were likely derived from headwater stream transfers with the Salmon River basin (Behnke 1992).

The Little Lost River Recovery Unit encompasses a sparsely populated area (*i.e.*, 1990 census population was 325). Howe, which is located at the downstream end of the Little Lost River valley, is the largest community

Figure 1. Bull trout recovery units in the United States. The Little Lost River Recovery Unit is highlighted.



(population was 20 in 1990). Land ownership in the Little Lost River basin is mixed. The Bureau of Land Management (43 percent) and the U.S. Forest Service (43 percent) manage the majority of lands within the recovery unit (LLRITAT 1998). Privately owned lands make up about 9 percent of the total land in the basin. The Idaho Department of Lands manages small land parcels interspersed within lands administered by the Bureau of Land Management. Lands of the Idaho National Environmental and Engineering Laboratory border the southern portion of the recovery unit.

The climate of the Little Lost River Recovery Unit is cool and dry (Table 1) (Gamett 1999). Annual precipitation varies with elevation, from 250 millimeters (9.8 inches) near Howe to over 1,000 millimeters (39.4 inches) in the Lost River Mountains. The annual mean precipitation near Howe was 239 millimeters (9.4

inches) for 1961 through 1990. Air temperatures at Howe range from –39 degrees Celsius (–38 degrees Fahrenheit) to 39 degrees Celsius (102 degrees Fahrenheit), with an annual mean of 6.3 degrees Celsius (43 degrees Fahrenheit).

Table 1. Mean annual and monthly air temperature and precipitation at Howe, Idaho (1961–1990) (Gamett 1999).

Month	Temperature (degrees Celsius)	Precipitation (centimeters)
January	-8.2	1.7
February	-4.7	1.6
March	0.9	1.4
April	7.2	1.5
May	12.0	2.9
June	16.3	3.4
July	20.3	1.9
August	19.1	2.4
September	13.4	1.7
October	7.2	1.3
November	-0.6	2.0
December	-7.3	2.1
Annual	6.3	23.9

Geology of the Little Lost River Recovery Unit is complex and consists primarily of sedimentary rock, limestone, quartzite, and shale (LLRITAT 1998). The basin has steep slopes, stream channels with many knickpoints, and relatively few meadows. Lands within the recovery unit are subject to rapid erosion and, in some locations, mass wasting (landslides). The basin has relatively high natural erosion rates that can be increased by intense land management activities.

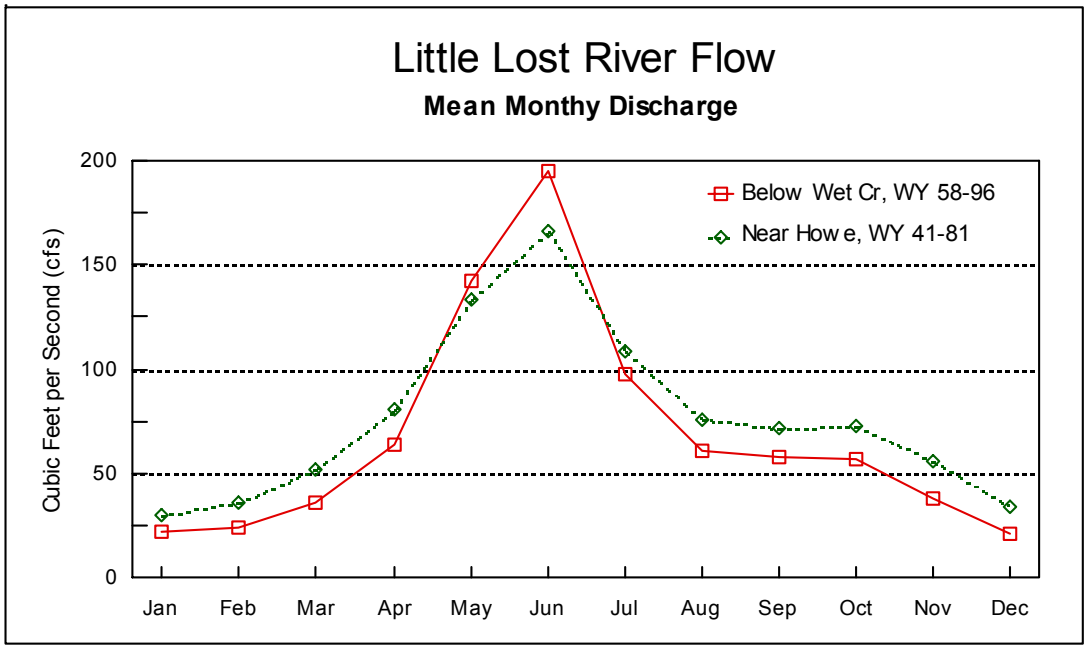
The Little Lost River basin includes 491 kilometers (305 miles) of perennial streams, 40 kilometers (259 miles) of perennial streams and marsh complexes, and 2,453 kilometers (1,525 miles) of intermittent streams (Gamett 1999). Stream flows are highly variable both seasonally and annually, but peak flows typically occur in June and minimum flows occur in December and January (Figure 2). During some portions of the year, flows from several tributaries entering the Little Lost River infiltrate into extensive alluvial fans before reaching the river. Overall, because most reaches of the Little Lost River are located above the water table, water is lost into the underlying alluvial sediments except at certain reaches (*e.g.*, below the confluences of Summit and Badger Creeks).

Fish Species. Eleven species of fish have been documented in the Little Lost River Recovery Unit: bull trout, brook trout (*Salvelinus fontinalis*), rainbow trout (*Oncorhynchus mykiss*), cutthroat trout (*O. clarki* subspecies), Arctic grayling (*Thymallus articus*), shorthead sculpin (*Cottus confusus*), guppy (*Poecilia reticulata*), green swordtail (*Xiphophorus helleri*), amelanic convict cichlid (*Cichlasoma nigrofasciatum*), Mozambique tilapia (*Tilapia mossambica*), and goldfish (*Carassius auratus*) (Gamett 1999). The latter four species are nonnatives that have been found in Barney Hot Springs or Barney Creek. Brown trout (*Salmo trutta*) and mountain whitefish (*Prosopium williamsoni*) have been reported in the basin. Except for bull trout and shorthead sculpin, the remaining species have been introduced into the Little Lost River basin, and whether rainbow trout, cutthroat trout, and mountain whitefish are native to the basin is uncertain. Golden trout (*O. aguabonita*) were introduced but did not establish a population. Hybrids from two pairs of species have also been observed (bull trout x brook trout and cutthroat trout x rainbow trout).

Stocking of hatchery-produced salmonids was discontinued throughout most of the Little Lost River basin in 1985 (Gamett 1999). Catchable-size rainbow are stocked into Big Springs Creek, and cutthroat trout are stocked in four mountain lakes (Swauger Lake #1, Swauger Lake #2, Mill Creek Lake, and Upper Big Creek Lake) every three years. Statewide general trout regulations are applied to stocked waters (*i.e.*, harvest of six trout), whereas the remaining basin is managed under wild trout regulations (*e.g.*, harvest of two cutthroat trout or cutthroat trout hybrids). Ten brook

trout may be harvested from all areas in the basin, and harvest of bull trout has been prohibited throughout the basin since 1994.

Figure 2. Mean monthly discharge of Little Lost River below the confluence of Wet Creek (water years 1958–1996) and near Howe (water years 1941–1981) (LLRITAT 1998).



DISTRIBUTION AND ABUNDANCE

Status of Bull Trout at the Time of Listing

In the final listing rule (63 FR 31647), the U.S. Fish and Wildlife Service identified three bull trout subpopulations in the Little Lost River basin: Wet Creek, Williams Creek, and Little Lost River (USFWS 1998). The Wet Creek subpopulation is isolated by an impassable waterfall, and the Williams Creek subpopulation is isolated by impassable irrigation diversions. The Little Lost River subpopulation was considered to occur in portions of the remainder of the basin. Although subpopulations were an appropriate unit upon which to base the 1998 listing decision, the recovery plan has revised the biological terminology to better reflect the current understanding of bull trout life history and conservation biology theory. Therefore, subpopulation terms will not be used in this chapter.

Current Distribution and Abundance

Bull trout have been collected from the Little Lost River and various tributaries by State and Federal resource agencies (Gamett 1999). Our knowledge of bull trout distribution within the recovery unit is based largely on presence-absence surveys and basinwide surveys that used electrofishing and snorkeling techniques. Surveys conducted from 1992 through 1999 indicate that bull trout have a wide, but fragmented, distribution in the Little Lost River basin (Appendix A). Bull trout occupy approximately 164 kilometers (101.9 miles) of streams and are the only salmonid present in approximately 32 kilometers (19.8 miles) of streams (Gamett 1999). Bull trout occur in the following streams: the upper reach of Badger Creek, upper reach of Big Creek, lower reach of Bunting Canyon Creek, lower reach of Camp Creek, Firebox Creek, Hawley Creek, Iron Creek, Jackson Creek, middle and upper reaches of the mainstem Little Lost River (including Sawmill Creek), Mill Creek, Quigley Creek, Redrock Creek, Smithie Fork, an unnamed tributary to Smithie Fork, Summit Creek, Timber Creek, Squaw Creek (Sawmill Canyon), North Fork Squaw Creek, lower reach of Slide Creek, upper reach of Warm Creek, Wet Creek (except for the middle section), and Williams Creek.

Bull trout were previously observed in some reaches and streams where they were not detected in recent surveys (1992 through 1999). Bull trout were found in the lower reach of the Little Lost River near Howe in 1983 (Corsi *et al*. 1986), which was prior to annual dewatering of this reach beginning in 1985, indicating that bull trout probably occupied all reaches of the river. Bull trout were not found in the reach during 1987 (Corsi and Elle 1989) or more recently (Gamett 1999). Bull trout were reported from Big Springs Creek in 1977 (Gamett 1999), lower Squaw Creek (Wet Creek watershed) in 1987 (Corsi and Elle 1989), and Dry Creek during the 1920's and 1960's (Gamett 1999). However, bull trout were not collected in these streams during surveys conducted in the 1990's (Gamett 1999). Because bull trout may exhibit a patchy distribution within a stream, detecting them may be difficult, even with relatively intensive sampling efforts (see Gamett [1999] for examples).

Abundance of bull trout (expressed as density, or the number of individuals per kilometer of stream) has declined in some areas of the Little Lost River and its tributaries. In the reach of the Little Lost River from the confluence of Summit Creek upstream to the National Forest boundary, bull trout density declined 91 percent between 1984 and 1993 (Table 2) (Gamett 1999). In the reach of the river between the National Forest boundary upstream to the confluence of Smithie Fork, bull trout density declined 62 percent between 1987 and 1995. Bull trout densities were higher in later surveys of both reaches, a finding that suggests that bull trout declines were probably related to low water levels and associated high temperatures due to drought, to degraded habitat conditions downstream of Warm Creek, and to angler harvest.

Bull trout abundance has declined in other tributaries of the Little Lost River basin. According to personal communications with local residents, relatively large bull trout (300 to 500 millimeters [11.8 to 19.7 inches]) were caught by anglers during the 1940's through the 1960's in Big Creek, a tributary in the Wet Creek watershed (Gamett 1999). Bull trout were also reported in 2 of 7 years of creel census data collected during 1969 through 1979 (63 and 16 percent of all species in 1974 and 1977, respectively). In 1978, brook trout were introduced in Big Creek. Gamett (1999) noted that five sites were sampled in Big

Table 2. Estimated densities (individuals per stream kilometer) of rainbow trout, brook trout, bull trout, and all species combined for two reaches of the Little Lost River from surveys conducted in the 1980's and 1990's (Gamett 1999).

Sample date	Rainbow trout	Brook trout	Bull trout	Species combined
Little Lost River—Summit Creek upstream to National Forest boundary				
October 1984	173	27	45	245
July 1985	83	32	61	176
July 1986	123	21	45	189
July 1987	150	52	24	226
August 1993	203	20	4	227
July 1997	208	16	21	245
Little Lost River—National Forest boundary upstream to Smithie Fork Creek				
July 1987	423	90	162	675
August-September 1995	499	33	62	594
July 1997	366	74	87	527

Creek during 1992 through 1997, and bull trout were collected at two sites. At these two sites, 2 and 6 percent of all trout collected were bull trout (2 bull trout and an apparent hybrid at one site; 7 apparent hybrids at the other), whereas 38 and 77 percent of all trout were brook trout. In 1999, no bull trout were collected at two other sites (USFS 1999). Presumed declines of bull trout in Big Creek are probably associated with brook trout interactions, and similar declines are probably occurring in Mill Creek and lower Squaw Creek (Sawmill Canyon). Sampling in Wet Creek during 2001 suggests that adult bull trout have undergone substantial declines in abundance (Table 1 of Appendix B).

Both resident and migratory (fluvial) bull trout exist in the Little Lost River Recovery Unit. Bull trout in the Little Lost River below Iron Creek road are fluvial

and migrate to headwater streams to spawn. The smallest bull trout captured in the Little Lost River downstream of Iron Creek Road (10 sampling sites) was 151 millimeters (5.1 inches) in total length (Gamett 1999). In 1987, Corsi and Elle (1989) found that age 1 and age 2 bull trout in the Little Lost River basin were 99 millimeters (3.4 inches) and 155 millimeters (5.3 inches) long, respectively. Data collected downstream of the National Forest boundary (Corsi *et al.* 1986; Corsi and Elle 1986; Elle *et al* 1987; Corsi and Elle 1989) indicate a lack of small bull trout in the Little Lost River downstream of this point. This lack of young-of-the-year and age 1 bull trout in the this area of the Little Lost River indicates that bull trout are spawning and rearing elsewhere.

The primary spawning areas for fluvial bull trout appear to be tributary streams in Sawmill Canyon. Bull trout over 300 millimeters (11.8 inches) long were observed in many streams of Sawmill Canyon during the spawning period in July, August, and September (Corsi and Elle 1989; Gamett 1999), indicating that these fish may be migratory. If so, fluvial bull trout may be migrating over 30 kilometers (18.6 miles) to spawn, and historically, bull trout may have migrated the length of the Little Lost River, over 80 kilometers (49.7 miles). High densities of young bull trout in Smithie Fork, the Little Lost River upstream of Smithie Fork, and Firebox Creek suggest that these streams are the most important spawning and rearing tributaries for fluvial bull trout. In 1995, bull trout densities (fish greater than 70 millimeters [2.8 inches]) long were as high as 30.3 fish per 100 square meters (2.8 fish per 100 square feet) in Smithie Fork and 20.4 fish per 100 square meters (1.9 fish per 100 square feet) in the Little Lost River upstream of Smithie Fork (Gamett 1999).

Relatively large bull trout have been observed in Wet Creek and in Big Creek, a tributary of Wet Creek, suggesting that these fish were fluvial (Gamett 1999). Bull trout up to 430 millimeters (16.9 inches) long have been recorded by electrofishing and creel surveys in Big Creek. Relatively large fish, up to 635 millimeters (25.0 inches) in length and 3.9 kilograms (8.6 pounds) in weight, that appeared to be bull trout x brook trout hybrids have been collected by electrofishing and angling in and around a beaver pond near the head of Big Creek. In July 1996, snorkelers observed bull trout over 300 millimeters (11.8 inches) long in Wet Creek in the beaver ponds immediately below Hilts Creek. The large size of these fish in relation to the size of

Wet Creek suggests that they were fluvial fish that migrated into these areas to spawn. For both Big Creek and Wet Creek, bull trout were probably migrating from lower Wet Creek and possibly from the Little Lost River. Length frequency data suggest that bull trout in Wet Creek above the falls that are located 0.8 kilometers (0.5 miles) above Hilts Creek are resident fish. The old diversion structure, falls, and cascades at this point are probably a barrier to upstream fish movement.

There is insufficient data to determine whether migratory bull trout occur in Mill Creek, Quigley Creek, Squaw Creek (Sawmill Canyon), Slide Creek, North Fork Squaw Creek, Warm Creek, or Badger Creek (Gamett 1999). Data on length frequency and length at sexual maturity suggest that bull trout in upper Squaw Creek (Sawmill Canyon) are resident fish. It is likely that fluvial bull trout from the Little Lost River historically used all of these streams for spawning and rearing. However, the bull trout currently found in these streams may be only remnants of a former fluvial population that has reverted to residency. In addition, resident fish may be sympatric with fluvial fish in streams such as Smithie Fork (Gamett 1999).

In the past, fluvial bull trout probably migrated into Williams Creek, but bull trout there now are residents (Gamett 1999). Since the late 1800's, Williams Creek has been permanently diverted for irrigation, and flow does not reach the Little Lost River. Therefore, bull trout inhabiting Williams Creek are completely isolated from fish in other portions of the Little Lost River basin.

REASONS FOR DECLINE

Within the Little Lost River Recovery Unit, elevated stream temperatures are probably the most limiting factor for bull trout (LLRITAT 1998). Land management activities, such as water diversions and improper grazing practices, that degrade aquatic and riparian habitats by altering stream flows and riparian vegetation may elicit or exacerbate unsuitable water temperature regimes for bull trout. Other factors that negatively affect bull trout in the Little Lost River Recovery Unit include habitat fragmentation and isolation due to fish passage barriers, interactions with nonnative brook trout, and possibly harvest of fish due to poaching and to misidentification by anglers. The following factors contributing to the decline of bull trout in the coterminous United States are discussed specifically for bull trout in the Little Lost River Recovery Unit.

Dams

Although there are no major storage dams on the Little Lost River, a flood-control structure (*i.e.*, a diversion dam and two infiltration ditches) was constructed 14 kilometers (8.7 miles) north of Howe to prevent flooding caused by ice jams in the channel (Gamett 1999). The flood-control structure was constructed in 1985 with funding from a Resource, Conservation, and Development grant (U.S. Department of Agriculture) and is operated by the Little Lost River Watershed Improvement District. Operation of the structure dewaters the lower 17 kilometers (10.5 miles) of the river during winter. The effects on fishes was estimated to be the loss of 4,200 trout, a loss that was mitigated by fish habitat improvement projects located in the river upstream of the confluence of Summit Creek in 1987. The trenches have screens to prevent fish from entering them, but the screens are typically removed because of clogging by ice and debris. The diversion dam is not screened and uses a recurved slide gate, which is typically closed incrementally to divert water into the trenches during the fall or early winter. Some bull trout were observed in isolated pools below the structure after the diversion gate was completely closed in fall 1999.

In accordance with the Endangered Species Act, the Bureau of Land Management and the U.S. Fish and Wildlife Service conducted formal consultation

on the flood-control project because the project was a major Federal action and because "take" of a listed species was occurring. On March 5, 2002, the U.S. Fish and Wildlife Service issued a biological opinion on the flood-control project (USFWS 2002). Terms and conditions in the biological opinion include conducting a feasibility study by December 2003 to develop an array of alternatives (*e.g.*, screening) to reduce or eliminate the loss of bull trout.

Operation of a hydroelectric project has negatively affected aquatic and riparian habitats in the lower portion of Wet Creek (BLM and USFWS 1998). Water is diverted from Dry Creek through a 20-kilometer (12.4-mile) pipeline to a power plant and is emptied into Wet Creek 4 kilometers (2.5 miles) upstream of the confluence with the Little Lost River. The combined flow from Wet Creek and Dry Creek have caused severe channel degradation for 1.8 kilometers (1.1 miles) downstream from the discharge point of the power plant. Although the hydroelectric project has degraded habitats in Wet Creek, a benefit to bull trout may be the cooling effect from Dry Creek water entering lower Wet Creek.

Forestry Management Practices

About 17 percent of the Little Lost River basin is forested in evergreen or mixed stands (LLRITAT 1998). Timber harvesting in the basin has typically been conducted at relatively small scales and primarily in the upper Sawmill Creek watershed. Although overall road density in the Sawmill Creek watershed is relatively low (0.63 kilometer per square kilometer [1.01 mile per square mile]), there are more roads in areas that have been harvested (IDEQ 1998a), and both roads and timber harvest are likely contributing sediment to streams. For example, recently observed slope failures between Jackson Creek and Slide Creek are associated with logging roads. Also, channel braiding, excessive fine sediments, and channel down-cutting are evident in areas of Timber Creek where streamside timber was harvested over 30 years ago. A relatively small area of the Little Lost River Recovery Unit is forested; however, forestry management practices have been applied in these areas, which include bull trout spawning and rearing habitat.

Two large wildfires have affected habitat conditions in the Sawmill Creek watershed (LLRITAT 1998). Both fires were stand replacing and determined to be human caused. In 1966, the Warm Creek fire burned 2,587 hectares (6,393 acres) of rangeland and forestland in the lower watershed. In 1988, the Little Lost fire burned 2,528 hectares (6,246 acres) in the Smithie Fork watershed in the upper, forested portion of that watershed. The effects of the large, high-intensity fires have affected and will continue to affect conditions of fish habitats for many years. Monitoring conducted by the Bureau of Land Management since 1986 for a riparian restoration project suggests that severe post-fire flooding degraded fish habitat in lower Sawmill Canyon. Lower Sawmill Canyon was heavily aggraded by sedimentation from the "blowout" resulting from increased runoff after the fire coupled with poor riparian conditions from intense grazing (BLM 1997). The abundance of native fishes declined after the debris floods of 1989 (BLM and USFWS 1998; Gamett 1999). The relation among forestry management practices (*e.g.*., fire suppression, road construction), the fires, and fish habitats in the Little Lost River Recovery Unit is uncertain.

Livestock Grazing

Livestock graze on private, State, and Federal lands over much of the Little Lost River Recovery Unit. Within the Sawmill Creek watershed, about 9,187 hectares (22,700 acres) are considered rangeland; this amount of land is about 39 percent of the entire of the watershed (LLRITAT 1998). Monitoring of grazing forage and riparian habitat in the Little Lost River basin has been limited. Approximately 15,770 cumulative animal unit months of cattle graze on State and Federal lands in the watershed according to recent estimates; grazing animals include 9,000 cattle and 10,000 sheep (BLM 1979, 1981).

Overgrazing can negatively affect bull trout habitat because of removal of riparian vegetation and trampling of streambanks. Such conditions can result in increased sedimentation rates, bank instability, and elevated water temperatures. High stream temperatures in the Little Lost River below Warm Creek appear to be a result of poor riparian and stream habitat conditions, poor conditions that can be compounded in drought years by low stream flows. Even though the upper portion of

this reach has experienced substantial regeneration of riparian vegetation because of a pilot riparian restoration project established in 1987 (BLM 1997), heavy grazing along the lower portion has impeded growth of woody riparian plants. The resulting erosion of streambanks has led to an unstable channel and to stream meandering in the reach, changes that have increased width-to-depth ratios and water temperatures and produced an unnaturally wide, shallow channel.

The effects of livestock grazing on aquatic and riparian habitats are prevalent factors affecting bull trout habitat in the Little Lost River Recovery Unit. Livestock grazing has degraded aquatic habitats in portions of Badger, Redrock, Wet, and Williams Creeks and contributed high proportions of fine sediments; such changes are probably negatively affecting spawning success of bull trout (Table 5 of Appendix B). Grazing in Wet Creek and the middle and lower reaches of the Little Lost River has degraded habitats used for rearing by juvenile and immature fish and has altered thermal regimes. Grazing on Federal lands in the Warm Creek, Iron Creek, Timber Creek, Smithie Fork Creek, and the upper Little Lost River watersheds is now conducted according to a grazing plan developed through consultation under the Endangered Species Act.

Agricultural Practices

The primary agricultural activities in the Little Lost River basin are crop production, pasture irrigation, and grazing with associated stock watering. Crop production (hay and grain) is limited to approximately 6 percent of the total basin area (LLRITAT 1998). Crop production also only occurs on private lands that are primarily in the valley near the towns of Howe, Fallert, and Clyde. Generally, crop production has the potential to modify hydrologic systems, accelerate sedimentation, and introduce agricultural chemicals into streams; however, crop production is not thought to directly affect bull trout persistence in the Little Lost River Recovery Unit.

Agricultural practices that rely on water diversions result in reduced stream flows and contribute to elevated stream temperature. The diversion structures also are often fish migration barriers. Diversion of surface water for irrigation dates back to the 1870's and has been supplemented by groundwater pumping since 1948.

Currently, more acreage in the Little Lost River basin is sprinkler irrigated than gravity irrigated (IDEQ 1998a), and sprinkler irrigation has lower potential to negatively affect bull trout. Bull trout may be lost in irrigation ditches, but the severity of fish loss in the basin is not known. Some water diversions divert all or a relatively large portion of the flow in some tributaries, such as diversions in Williams and Badger Creeks, and have isolated the streams from the Little Lost River. Numerous water diversions on the Little Lost River, especially in the lower Little Lost River, have probably increased summer water temperatures and reduced habitat quality for bull trout.

Overall, the Little Lost River has experienced extensive channelization and diversion since the late 1800's. Aerial photographs show that much of the Little Lost River between the National Forest boundary and Summit Creek (*i.e.*, middle Little Lost River) has been channelized (Gamett 1999). Although channelized reaches are no longer maintained and are gradually returning to more natural conditions, the effects of channelization on water temperatures and habitat quality are probably still affecting bull trout.

Transportation Networks

Generally, watersheds with the highest road densities are areas where bull trout no longer exist. Overall road density on timber and grazing lands of the Little Lost River Recovery Unit is lower than that for other areas having a substantial portion of public lands (*i.e.*, for public lands outside of roadless and wilderness areas). Road densities in the Little Lost River basin average approximately 0.63 kilometer per square kilometer (1.01 mile per square mile). Some areas in the Sawmill Creek watershed with higher road densities include Timber, Quigley, and Bear Creeks. Bull trout are generally more abundant in the upper Sawmill Canyon and Smithie Fork roadless areas than in other areas of the recovery unit (see Gamett 1999). Sediment from roads, trails, and grazing may be degrading bull trout spawning and rearing habitat in Badger, Iron, Timber, and Wet Creeks (Table 5 of Appendix B).

Mining

Beginning in the 1890's and continuing to the early 1990's, Sawmill Canyon contained localized mining activities (LLRITAT 1998). Mining activity in the canyon primarily consisted of shaft mines in the eastern portion of the watershed. Recreational mining does not appear to be an issue in the Little Lost River Recovery Unit, and there are currently no active mining claims. Therefore, mining is not likely to be negatively affecting bull trout in the Little Lost River Recovery Unit at this time.

Residential Development and Urbanization

Although the Little Lost River Recovery Unit is sparely populated, with an estimated population of fewer than 400 residents (LLRITAT 1998), available private lands are often used for vacation homes and seasonal occupancy. Private ponds and stream alterations often accompany the development of recreational properties, posing risks to riparian habitat and fish passage. Such development also encourages the introduction of exotic species (*e.g.*, brown trout) into private ponds and stream reaches. Areas of concern include Wet Creek, Big Creek, Summit Creek, Badger Creek, Squaw Creek (Wet Creek drainage), and the Little Lost River, including the middle reach of Sawmill Canyon. Although no negative effects on bull trout habitat are currently documented, residential development coinciding with generally increasing development potentially threatens important bull trout habitats.

Fisheries Management

Brook trout, rainbow trout, and cutthroat trout were introduced into the Little Lost River basin by at least 1915 (LLRITAT 1998). Although brown trout have not been documented in the basin, they have reportedly been caught in the lower portion of the basin in recent years (Gamett 1999). Brook trout are widely distributed in the basin; however, they are abundant only in a few stream reaches. Brook trout were found in Big Creek, Big Springs Creek, Dry Creek, an unnamed tributary to Meadow Creek, Mill Creek, Squaw Creek (Sawmill Canyon), an unnamed tributary to Squaw Creek (Sawmill Canyon), North Fork Squaw Creek, upper Summit Creek, Uncle Ike

Creek, Wet Creek, and portions of the mainstem Little Lost River (Gamett 1999). Brook trout comprised 25 percent or more of the salmonids captured in upper Big Creek, Dry Creek, the mainstem near Mill Creek, an unnamed tributary to Meadow Creek, Mill Creek, lower Squaw Creek (Sawmill Canyon), an unnamed tributary to Squaw Creek (Sawmill Canyon), the lower reach of North Fork Squaw Creek, and Uncle Ike Creek.

Brook trout distribution within the recovery unit has apparently increased during the last 25 years (Gamett 1999). For example, in the 1970's, brook trout were not collected at sites in the Little Lost River from Howe upstream to within the Sawmill Canyon area. But brook trout are currently found throughout most of the Little Lost River (Corsi *et al.* 1986; Corsi and Elle 1986, Corsi and Elle 1989; Gamett 1999). Brook trout were also introduced into Big Creek in 1978, and made up 19 to 77 percent of the salmonids captured at sites sampled in 1994 and 1996 (Gamett 1999). The upstream distribution of brook trout in Sawmill Canyon appears to have remained the same since 1987, possibly because of water temperature and stream gradient.

Although hybridization between brook trout and bull trout in the Little Lost River basin does not appear widespread, fish appearing to be hybrids have been observed in the recovery unit. Gamett (1999) found apparent hybrids in lower and mid Squaw Creek (Sawmill Canyon drainage), Mill Creek, the Little Lost River near Mill Creek, and the upper reach of Big Creek. These same stream reaches also had very few fish that appeared to be pure bull trout. Genetic tests confirmed that a large fish (635 millimeters [25.0 inches] in length, 3.9 kilograms [8.6 pounds] in weight) captured by hook and line in the Big Creek beaver pond was a hybrid. Surveys conducted by the Bureau of Land Management in 2001 documented a bull trout x brook trout hybrid in lower Wet Creek (P. Koelsch, Bureau of Land Management, pers. comm., 2001).

The introduction of brook trout into Big Creek appears to be associated with the decline of bull trout. Likewise, the apparent extirpation of bull trout from Dry Creek appears linked to the introduction of brook trout. Similar declines appear to be occurring in Mill Creek and Squaw Creek (Sawmill Canyon drainage). If these

trends continue, bull trout may disappear from these streams. Also, an expansion of brook trout into streams such as Smithie Fork Creek or Wet Creek would probably eliminate bull trout.

Since 1987, rainbow trout in Sawmill Canyon have expanded into areas previously occupied by only bull trout. In 1970 and 1987, only bull trout were collected in the Sawmill Canyon drainage above Mill Creek (Corsi and Elle 1989). Specifically, rainbow trout were not collected in the Little Lost River near Moonshine Creek. However, rainbow trout comprised 26 percent and 13 percent of the salmonids captured in this reach in 1995 and 1997, respectively. Likewise, bull trout was the only salmonid captured from lower Timber Creek in 1987 (Corsi and Elle 1989). In 1995 and 1997, rainbow trout comprised 14 percent and 5 percent, respectively, of the salmonids collected in this reach. These data suggest that, between 1987 and 1995, rainbow trout advanced between 1.9 kilometers (1.2 miles) and 6.6 kilometers (4.1 miles) up the Little Lost River and into the lower reaches of Timber Creek.

Cutthroat trout have been introduced throughout the Little Lost River drainage (LLRITAT 1998). The earliest cutthroat trout introduction in the drainage may have been in Dry Creek in 1915. Determining where fish were stocked before 1953 is difficult because introductions before that date were listed only by hatchery or county. State stocking records indicate that on June 1, 1915, 25,000 "natives" (probably cutthroat trout), 10,000 brook trout, and 55,000 rainbow trout were given to E.H. Motts in Mackay for "Dry Creek." The June 2, 1915, edition of the *Mackay Miner* (a local newspaper based in Mackay) indicates that fish had been planted in Dry Creek. Idaho Department of Fish and Game stocking records indicate that 26,200 cutthroat trout had been introduced into the basin in 1936. By 1947, cutthroat trout were introduced into Big Creek and Wet Creek. Dry Creek received additional plantings of cutthroat trout in 1964. Cutthroat trout have also been introduced into Big Creek Lake #2, Copper Lake, Mill Creek Lake, Shadow Lake #1, Shadow Lake #2, Swauger Lake #1, and Swauger Lake #2. And cutthroat trout may have been introduced into other streams, such as Mill Creek and Squaw Creek.

Competitive and predator–prey relations among bull trout, brook trout, rainbow trout, and cutthroat trout and the effects of those relationships on bull trout in the recovery unit are not known. Declines in bull trout have been associated with introductions of nonnative fish such as brook trout (Rieman and McIntyre 1993). In the Little Lost River, however, the decline in bull trout abundance accompanied by an increase in rainbow trout abundance is probably because of high stream temperatures selecting against bull trout rather than because of direct competition from rainbow trout.

Periodic increased fishing activity during spring and summer holidays probably results in incidental harvest of bull trout, particularly where public access is greatest to prime bull trout habitat. In the past, negative effects of angling may have been a limiting factor for bull trout. Anglers could legally harvest up to 6 bull trout daily. In 1987, bull trout accounted for 53 percent of the fish caught by anglers in Sawmill Creek (Corsi and Elle 1989), and 71 percent of the bull trout that were caught were harvested. In 1994, the Idaho Department of Fish and Game implemented "no harvest" regulations.

In 1994, wild trout regulations were implemented in the majority of the basin (above the confluence of Big Springs Creek). These regulations allow for the harvest of two trout per day in the river and tributaries above Big Springs Creek. High mountain lakes and the drainage below, and including, Big Springs Creek remain under the general trout regulation that allows six trout to be harvested. However, only two cutthroat trout or rainbow trout x cutthroat trout hybrids may be harvested from any stream. The statewide regulation allowing an additional 10 brook trout remains in effect throughout the drainage (Gamett 1999).

Accidental angler harvest may be negatively affecting bull trout. Bull trout and brook trout can be difficult to differentiate, and this difficulty can result in anglers accidentally harvesting bull trout. Intentional violation of the existing "no harvest" regulations may also be occurring. For example, an agency fish survey crew, while electrofishing the upper Sawmill Canyon reach of the Little Lost River after the Fourth of July holiday in 1997, observed several large bull trout heads that were obviously harvest mortalities (Gamett 1999).

Bull trout mortalities due to anglers misidentifying fish, mishandling fish, or not complying with regulations may be negatively affecting bull trout in the Little Lost River Recovery Unit. However, the degree that angling mortality has contributed to the decline of bull trout and continues to affect them in the recovery unit is uncertain. Factors associated with fishing should be evaluated, especially in popular fishing areas (*e.g.*, the entire Little Lost River [upper, middle, and lower portions], Wet Creek, Timber Creek, and Smithie Fork Creek), and actions to reduce any negative effects (*e.g.*, increase bull trout identification programs, and revise regulations) should be implemented where appropriate.

Isolation and Habitat Fragmentation

There are several types of barriers to migration of bull trout (adults and juveniles) in the Little Lost River Recovery Unit. The barriers include culverts, seasonal thermal barriers, water diversion structures (*e.g.*, irrigation diversions and the flood-control structure near Howe), hydropower development on Dry Creek, and natural barriers (LLRITAT 1998). Overall, barriers fragment available habitats for bull trout and isolate fish.

Culverts can be migration barriers, particularly in areas with a high density of roads and numerous stream crossings. Problem culverts typically pose velocity barriers to adult and juvenile fish movement, but perched culverts are often height barriers that either injure fish attempting to negotiate them or entirely prevent fish passage. A culvert on Moonshine Creek, a tributary to the upper Little Lost River, may be preventing bull trout access to potentially suitable but unoccupied habitat upstream in the creek. Culverts on Jackson, Hawley, Timber, and Redrock Creeks and on the upper Little Lost River may be inhibiting passage of juvenile bull trout and should be evaluated and, if necessary, modified (Appendix B).

Natural migration barriers include waterfalls, debris slides, beaver dams, gradients over 6 percent, and infiltration of stream flow into alluvial substrate (LLRITAT 1998). Beaver dams do not appear to be barriers in the Little Lost River Recovery Unit; however, decadent beaver dams in Quigley Creek may be inhibiting fish passage. Falls higher than 1 meter (3.3 feet) occur on Big Creek, Smithie Fork

Creek, an unnamed tributary to Smithie Fork Creek, and Wet Creek. Wet Creek also has a potential gradient barrier, exacerbated by a diversion structure 0.8 kilometer (1.3 miles) above Hilts Creek. Flow from Mill Creek Lake infiltrates through a historic slide, blocking fish passage into the lake. Steep gradient is an apparent barrier on Slide Creek.

Both Badger and Williams Creeks are isolated from the Little Lost River during all or portions of the year due to irrigation diversions, and bull trout are isolated within the streams (Gamett 1999). In Badger Creek, bull trout are restricted to a relatively short reach of the stream and to the lower 300 meters (984 feet) of Bunting Canyon Creek. Debris and possibly a head-cut have created a 1-meter (3.3-feet) waterfall 300 meters up the tributary. The waterfall prevents bull trout access to about 3 kilometers (1.9 miles) of apparently suitable habitat.

Unsuitable water temperatures, which may be due to a combination of natural conditions (*e.g.*, low flow and high water infiltration) and management-induced conditions (*e.g.*, low riparian vegetation due to overgrazing, water diversions), may seasonally isolate bull trout. Temperature data from several years are available for some locations, including the Little Lost River at the National Forest boundary and upstream of Summit Creek. Data were collected from these two sites in 1987, 1988, 1994, 1995, and 1997 (Gamett 1999). Maximum stream temperatures at both stations were consistently above 15 degrees Celsius (59 degrees Fahrenheit) during the summer and often reached above 20 degrees Celsius (68 degrees Fahrenheit). During 1994, a hot, dry year, stream temperatures at the National Forest boundary exceeded 20 degrees Celsius (68 degrees Fahrenheit) for 17 days but did not exceed 25 degrees Celsius (77 degrees Fahrenheit). However, in the Little Lost River above Summit Creek, stream temperatures exceeded 20 degrees Celsius (68 degrees Fahrenheit) for 55 days and exceeded 25 degrees Celsius (77 degrees Fahrenheit) for 10 days. Farther downstream, cooler waters from Wet Creek resulted in lower temperatures. The maximum stream temperature recorded in this stream reach was 27 degrees Celsius (81 degrees Fahrenheit) in July 1994 at the old gauging station, which is 3.2 kilometers (2 miles) upstream of the Summit Creek confluence.

ONGOING RECOVERY UNIT CONSERVATION MEASURES

Several activities that have been implemented and are ongoing will improve bull trout and their habitats in the Little Lost River Recovery Unit. The following discussion provides examples of completed and ongoing conservation activities.

Federal Activities

For all proposed Federal activities in the recovery unit, the Salmon-Challis National Forest and Bureau of Land Management are consulting with the U.S. Fish and Wildlife Service in accordance with section 7 of the Endangered Species Act. During consultations, potential effects of proposed activities on bull trout and their habitats are evaluated, and the activities may be modified to reduce or eliminate negative effects on bull trout. Federal activities often include conservation measures beneficial to bull trout, such as reducing sediment delivery to streams by closing or altering forest roads and grazing practices, providing fish passage by replacing improperly constructed culverts, and conducting fish and habitat surveys (see USFWS 1999, 2002). For example, the Forest Service has closed some roads in upper Sawmill Creek, Wet Creek, and Badger Creek to reduce erosion and sediment delivery to streams. Grazing on Federal lands in the Warm Creek, Iron Creek, Timber Creek, Smithie Fork Creek, and the upper Little Lost River watersheds is now conducted according to a grazing plan developed through consultation under the Endangered Species Act. The grazing plan improves past management practices and is adjusted based on the results of monitoring.

The Natural Resources Conservation Service and the Farm Services Agency administer several programs that provide technical or financial assistance, or both, to private landowners to address natural resource problems. Resource management systems are developed with landowners to address concerns about soil, water, air, plant, and animal resources. Programs available to private landowners include the Conservation Reserve Program (CRP), Environmental Quality Incentives Program (EQIP), Wetland Reserve Program (WRP), and Wildlife Habitat Incentives Program (WHIP). Resource management systems are developed with landowners to identify practices that will reduce soil erosion and sediment delivery to streams, restore riparian and wetland functions and values, reduce water consumption on irrigated

agricultural lands, and reduce nutrient and pesticide pollution in water bodies. Typical practices include riparian forest buffers, fencing, use exclusion, irrigation water management, nutrient and pesticide management, prescribed grazing, and livestock watering facilities.

Under sections 303 and 304 of the Federal Clean Water Act, States or the U.S. Environmental Protection Agency set water quality standards, which combine designated beneficial uses and criteria established to protect uses. States or the Environmental Protection Agency designate water bodies that are failing water quality standards as water quality limited under section 303(d); management plans are then required to be developed for those water bodies. Management plans include total maximum daily loads and implementation plans that define site-specific actions and time lines for meeting water quality goals. Four stream reaches in the Little Lost River Recovery Unit appear on Idaho's 1998 303(d) list: two reaches in the Little Lost River and one each in Sawmill Creek and Wet Creek (IDEQ 1998b). Streams were listed for various reasons (*e.g.*, for flow alteration, sediment, temperature) and include reaches coinciding with the distribution of bull trout. For the Little Lost River drainage, the Idaho Department of Environmental Quality has completed a subbasin assessment (IDEQ 1998a), which was accepted by the U.S. Environmental Protection Agency in 2000. Agencies are currently developing implementation plans to address beneficial uses (Koelsch, pers. comm., 2001).

State of Idaho

The Idaho Department of Fish and Game has implemented ongoing conservation measures to benefit bull trout. Bull trout harvest has been prohibited statewide since 1994. The agency has also conducted creel surveys and surveys to determine the distribution of fishes. With the cooperation of the U.S. Forest Service, the Idaho Department of Fish and Game has initiated education efforts to help the public distinguish between bull trout and brook trout. Efforts involved erecting a kiosk display in Mackay, placing large signs at the National Forest boundary in Sawmill Canyon and at the Timber Creek Campground, placing small signs at key locations throughout the drainage, and distributing pamphlets about bull trout (Gamett 1999). Although citations written for possession of bull trout have decreased

following efforts to provide information to the public, discussions with anglers suggest that many are still not able to identify bull trout

In the past, various agencies have preformed projects benefitting bull trout on private lands. For example, a diversion structure that was constructed on Wet Creek 1.5 kilometers (0.9 mile) upstream from the Little Lost River may have been a complete barrier to upstream fish passage (LLRITAT 1998). The Bureau of Land Management, in cooperation with the Idaho Department of Fish and Game and the U.S. Forest Service, constructed a fish ladder at the structure to provide fish passage. In 1998, Butte County replaced a bridge with a culvert in Wet Creek that the Bureau of Land Management and Idaho Department of Water Resources found to be a fish migration barrier because of excessive water velocities (Koelsch, pers. comm., 2001). The County replaced the culvert according to Bureau of Land Management specifications.

STRATEGY FOR RECOVERY

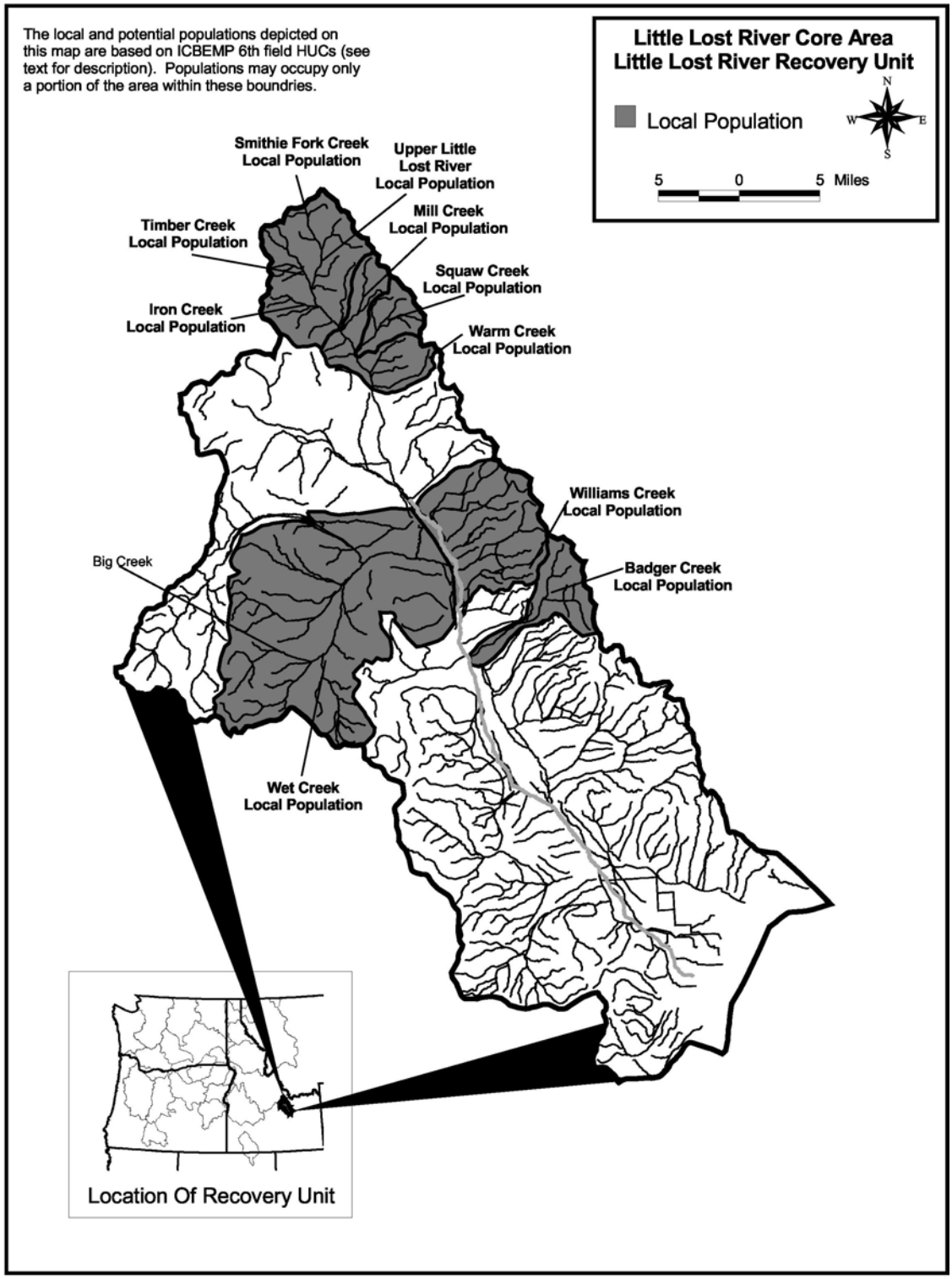
A core area represents the closest approximation of a biologically functioning unit for bull trout. The combination of core habitat (*i.e.*, habitat that could supply all the necessary elements for the long-term security of bull trout, including for both spawning and rearing, as well as for foraging, migrating, and overwintering) and a core population (*i.e.*, bull trout inhabiting a core habitat) constitutes the basic core area upon which to gauge recovery within a recovery unit. Within a core area, many local populations may exist.

Bull trout are distributed widely in the Little Lost River Recovery Unit, with individuals occurring from the headwaters in the upper Little Lost River to below the flood-control structure near Howe. Bull trout have been observed in about 20 streams since the 1980's (Appendix A). Both resident and migratory (fluvial) bull trout occur in the recovery unit, and migratory individuals probably use spawning and rearing habitat in streams in the upper portion of the Little Lost River (*e.g.*, Firebox Creek, Smithie Fork Creek, and Iron Creek watersheds) and perhaps the Wet Creek drainage. The Little Lost River Recovery Unit consists of a single core area, which includes the mainstem river and tributaries in which bull trout have been observed (Figure 3). The core area includes 10 local populations (Table 3).

Table 3. Core area and local populations in the Little Lost River Recovery Unit, Idaho.

Recovery unit	Core area	Local populations
Little Lost River	Little Lost River	1. Badger Creek (including Bunting Canyon Creek) 2. Williams Creek 3. Wet Creek (including Big Creek) 4. Warm Creek 5. Squaw Creek (tributary to Sawmill Creek) 6. Mill Creek 7. Iron Creek (including Hawley and Jackson creeks) 8. Timber Creek (including Camp, Redrock, and Slide creeks) 9. Smithie Fork Creek 10. Upper Little Lost River (Iron Creek confluence to headwaters, excluding the Timber Creek and Smithie Fork Creek watersheds)

Figure 3. Location of bull trout local populations within the Little Lost River Recovery Unit.



Recovery Goals and Objectives

The goal of the bull trout recovery plan is to **ensure the long-term persistence of self-sustaining, complex, interacting groups of bull trout distributed throughout the species' native range so that the species can be delisted.** To achieve this goal, the following objectives have been identified for bull trout in the Little Lost River Recovery Unit:

- Maintain current distribution of bull trout and restore distribution in previously occupied areas within the Little Lost River Recovery Unit.

- Maintain stable or increasing trends in abundance of bull trout in the Little Lost River Recovery Unit.

- Restore and maintain suitable habitat conditions for all bull trout life history stages and strategies.

- Conserve genetic diversity and provide opportunity for genetic exchange.

Rieman and McIntyre (1993) and Rieman and Allendorf (2001) evaluated the bull trout population numbers and habitat thresholds necessary for long-term viability of the species. They identified four elements, and the characteristics of those elements, to consider when evaluating the viability of bull trout populations. These four elements are 1) number of local populations; 2) adult abundance (defined as the number of spawning fish present in a core area in a given year); 3) productivity, or the reproductive rate of the population (as measured by population trend and variability); and 4) connectivity (as represented by the migratory life history form and functional habitat). For each element, the Little Lost River Recovery Unit Team classified bull trout into relative risk categories based on the best available data and the professional judgment of the team.

The Little Lost River Recovery Unit Team also evaluated each element under a potential recovered condition to produce recovery criteria. Evaluation of these elements under a recovered condition assumed that actions identified within this chapter had been implemented. Recovery criteria for the Little Lost River Recovery Unit reflect 1) the

stated objectives for the recovery unit, 2) evaluation of each population element in both current and recovered conditions, and 3) consideration of current and recovered habitat characteristics within the recovery unit. Recovery criteria will probably be revised in the future as more detailed information on bull trout population dynamics becomes available. Given the limited information on bull trout, both the level of adult abundance and the number of local populations needed to lessen the risk of extinction should be viewed as a best estimate.

This approach to developing recovery criteria acknowledges that the status of populations in some core areas may remain short of ideals described by conservation biology theory. Some core areas may be limited by natural attributes or by patch size and may always remain at a relatively high risk of extinction. Because of limited data within the Little Lost River Recovery Unit, the recovery unit team relied heavily on the professional judgment of its members.

Local Populations. Metapopulation theory is important to consider in bull trout recovery. A metapopulation is an interacting network of local populations with varying frequencies of migration and gene flow among them (Meffe and Carroll 1994) (see Chapter 1). Multiple local populations distributed and interconnected throughout a watershed provide a mechanism for spreading risk from stochastic events. In part, distribution of local populations in such a manner is an indicator of a functioning core area. Based in part on guidance from Rieman and McIntyre (1993), bull trout core areas with fewer than 5 local populations are at increased risk, core areas with between 5 and 10 local populations are at intermediate risk, and core areas with more than 10 interconnected local populations are at diminished risk. The Little Lost River Recovery Unit contains one core area, the Little Lost River core area. For the Little Lost River Core Area, there are currently 10 known local population. According to the above guidance, bull trout in the Little Lost River Core Area is at intermediate risk.

Adult Abundance. The recovered abundance levels in the Little Lost River Recovery Unit were determined by considering theoretical estimates of effective population size, historical census information, and the professional judgment of recovery team members. In general, effective population size is a theoretical concept that allows us to predict potential future losses of genetic variation within a population due to small

population sizes and genetic drift (see Chapter 1). For the purpose of recovery planning, effective population size is the number of adult bull trout that successfully spawn annually. Based on standardized theoretical equations (Crow and Kimura 1970), guidelines have been established for maintaining minimum effective population sizes for conservation purposes. Effective population sizes of greater than 50 adults are necessary to prevent inbreeding depression and a potential decrease in viability or reproductive fitness of a population (Franklin 1980). To minimize the loss of genetic variation due to genetic drift and to maintain constant genetic variance within a population, an effective population size of at least 500 is recommended (Franklin 1980; Soule 1980; Lande 1988). Effective population sizes required to maintain long-term genetic variation that can serve as a reservoir for future adaptations in response to natural selection and changing environmental conditions are discussed in Chapter 1 of the recovery plan.

For bull trout, Rieman and Allendorf (2001) estimated that a minimum number of 50 to 100 spawners per year is needed to minimize potential inbreeding effects within local populations. In addition, a population size of between 500 and 1,000 adults in a core area is needed to minimize the deleterious effects of genetic variation from drift.

For the purposes of bull trout recovery planning, abundance levels were conservatively evaluated at the local population and core area levels. Local populations containing fewer than 100 spawning adults per year were classified as at risk from inbreeding depression. Bull trout core areas containing fewer than 1,000 spawning adults per year were classified as at risk from genetic drift.

Adult abundance in the Little Lost River Core Area was estimated at 6,250 adults in the 10 known local populations. According to the guidance on abundance above, bull trout in the Little Lost River Core Area are not considered at risk of genetic drift.

Productivity. A stable or increasing population is a key criterion for recovery under the requirements of the Endangered Species Act. Measures of the trend of a population (the tendency to increase, decrease, or remain stable) include population growth rate or productivity. Estimates of population growth rate (*i.e.*, productivity over the entire life cycle) that indicate a population is consistently failing to replace itself also indicate an

increased risk of extinction. Therefore, the reproductive rate should indicate that the population is replacing itself, or growing.

Since estimates of the total population size are rarely available, the productivity or population growth rate is usually estimated from temporal trends in indices of abundance at a particular life stage. For example, redd counts are often used as an index of a spawning adult population. The direction and magnitude of a trend in the index can be used as a surrogate for the growth rate of the entire population. For instance, a downward trend in an abundance indicator may signal the need for increased protection, regardless of the actual size of the population. A population that is below recovered abundance levels, but that is moving toward recovery, would be expected to exhibit an increasing trend in the indicator.

The population growth rate is an indicator of probability of extinction. This probability cannot be measured directly, but it can be estimated as the consequence of the population growth rate and the variability in that rate. For a population to be considered viable, its natural productivity should be sufficient for the population to replace itself from generation to generation. Evaluations of population status will also have to take into account uncertainty in estimates of population growth rate or productivity. For a population to contribute to recovery, its growth rate must indicate that the population is stable or increasing for a period of time.

Based on the stable population trend and the number of adult bull trout and local populations in the Little Lost River Core Area, bull trout are considered to be at a diminishing risk.

Connectivity. The presence of the migratory life history form within the Little Lost River Recovery Unit was used as an indicator of the functional connectivity of the recovery unit. If the migratory life form was absent, or if the migratory form was present but local populations lacked connectivity, the core area was considered to be at increased risk. If the migratory life form persisted in at least some local populations, with partial ability to connect with other local populations, the core area was judged to be at intermediate risk. Or if the migratory life form was present in all or nearly all local populations and if that form had the ability to connect with other local populations, the core area was considered to be at diminished risk. Migratory bull trout may persist in some local

populations in the Little Lost River Core Area and, therefore, are considered to be at an intermediate risk.

Recovery Criteria

Recovery criteria (summarized in Table 4) for bull trout in the Little Lost River Recovery Unit are the following:

1. **Distribution criteria will be met when the current distribution of bull trout in the 10 local populations that have been identified is maintained.** Existing local populations include Badger Creek, Williams Creek, Wet Creek (including Big Creek), Warm Creek, Squaw Creek, Mill Creek, Iron Creek (including Hawley and Jackson Creeks), Timber Creek (including Camp, Redrock, and Slide Creeks), Smithie Fork Creek, and the upper Little Lost River (Iron Creek confluence to headwaters, excluding the Timber Creek and Smithie Fork Creek watersheds). The recovered distribution of bull trout in the Wet Creek local population requires fish in Big Creek, a tributary to Wet Creek.

Table 4. Summary of values for recovery criteria in the Little Lost River Recovery Unit.

Recovery unit	Number of core areas	Number of local populations	Adult abundance	Trend in abundance	Number of barriers addressed
Little Lost River	1	10	6,750	stable-increasing	4

2. **Abundance criteria will be met when the estimated abundance of adult bull trout is at least 6,750 individuals in the Little Lost River Recovery Unit.** Using professional judgment, the Little Lost River Recovery Unit Team estimated abundance of adult bull trout for the recovery unit by using surveys of fish densities and considering current habitat conditions and potential conditions after threats have been addressed. Because most bull trout in the recovery unit are resident fish, fish that are 180 millimeters (7.1 inches) or longer were considered adults.

Minimum abundance of adult bull trout per local population to meet the criterion are presented in Appendix C.

3. **Trend criteria will be met when adult bull trout exhibit stable or increasing trends in abundance, over at least two generations, in the Little Lost River Recovery Unit.**

4. **Connectivity criteria will be met when specific barriers to bull trout migration in the Little Lost River Recovery Unit have been addressed.** Tasks to identify and assess barriers to bull trout passage are recommended in this recovery plan. Sites and activities necessary to fulfill connectivity criteria include the following: evaluating passage options at the diversion structures in the lower reaches of Badger and Williams Creeks (tasks 1.2.1, 1.2.2, and 1.2.3), at the falls created by debris and perhaps a head-cut in Bunting Creek (task 1.2.13), and at the flood-control structure near Howe (task 1.2.11); implementing appropriate actions based on the results of the options evaluated in the tasks (tasks appear in the Recovery Measures Narrative and the Implementation Schedule); and conducting coordinated review with the U.S. Fish and Wildlife Service during implementation of the tasks.

Recovery criteria for the Little Lost River Recovery Unit were established to assess whether recovery actions are resulting in the recovery of bull trout. The Little Lost River Recovery Unit Team expects that the recovery process will be dynamic and will be refined as more information becomes available. While removal of bull trout as a listed species under the Endangered Species Act (*i.e.*, delisting) can only occur for the entity that was listed (Columbia River distinct population segment), the criteria listed above will be used to determine when the Little Lost River Recovery Unit Recovery Unit is fully contributing to recovery of the population segment.

ACTIONS NEEDED

Recovery Measures Narrative

In this chapter and all other chapters of the bull trout recovery plan, the recovery measures narrative consists of a hierarchical listing of actions that follows a standard template. The first-tier entries are identical in all chapters and represent general recovery tasks under which specific (*e.g.*, third-tier) tasks appear when appropriate. Second-tier entries also represent general recovery tasks under which specific tasks appear. Second-tier tasks that do not include specific third-tier actions are usually programmatic activities that are applicable across the species' range; they appear in *italic type*. These tasks may or may not have third-tier tasks associated with them; see Chapter 1 for more explanation. Some second-tier tasks may not be sufficiently developed to apply to the recovery unit at this time; they appear in *a shaded italic type (as seen here)*. These tasks are included to preserve consistency in numbering tasks among recovery unit chapters and intended to assist in generating information during the comment period for the draft recovery plan, a period when additional tasks may be developed. Third-tier entries are tasks specific to the Little Lost River Recovery Unit. They appear in the Implementation Schedule that follows this section and are identified by three numerals separated by periods.

The Little Lost River Recovery Unit chapter should be updated or revised as recovery tasks are accomplished, environmental conditions change, or monitoring results or other new information becomes available. Revisions to the Little Lost River Recovery Unit chapter will probably focus on priority streams or stream segments within core areas where restoration activities occurred and where habitat or bull trout populations have shown a positive response. The Little Lost River Recovery Unit Team should meet annually to review annual monitoring reports and summaries and to make recommendations to the U.S. Fish and Wildlife Service.

1 Protect, restore, and maintain suitable habitat conditions for bull trout.

1.1 Maintain or improve water quality in bull trout core areas or potential core habitat.

1.1.1 Develop and implement a management strategy to reduce sediment levels on National Forest and private lands in the Badger Creek watershed. Habitat alterations from roads and grazing in the upper portions of the watershed have contributed to high levels of sediment. Natural resource agencies (*e.g.*, the U.S. Forest Service, Natural Resources Conservation Service) and private landowners should develop and implement a strategy to reduce sediment levels on both public and private lands in the Badger Creek watershed.

1.1.2 Reduce sediment from roads and trails in the Iron Creek and Timber Creek watersheds. Mass wasting, erosion, and unstable streambanks associated primarily with roads and trails are contributing high levels of sediment to the two watersheds. Actions (*e.g.*, relocation, closure, obliteration, or other modifications of roads and trails) need to be implemented to reduce sediment levels.

1.1.3 Develop and implement a management strategy to reduce sediment levels in bull trout spawning and rearing habitat in the Wet Creek watershed. Habitat alterations from roads, grazing, and trails in the upper portion of the watershed have contributed to high levels of sediment. Natural resource agencies (*e.g.*, the U.S. Forest Service, Natural Resources Conservation Service) and private landowners should develop and implement a strategy to reduce sediment levels on both public and private lands in the Wet Creek watershed.

1.2 Identify barriers or sites of entrainment for bull trout and implement tasks to provide passage and eliminate entrainment.

1.2.1 Provide upstream fish passage at the Badger Creek water diversion. A water diversion on Badger Creek blocks upstream fish passage and periodically dewaters the lower 0.5 kilometer (0.3 mile) of the stream during summer months. Upstream fish passage should be provided at the diversion structure.

1.2.2 Assess feasibility of providing minimum stream flows between the Badger Creek diversion and the Little Lost River. Badger Creek is periodically isolated from the Little Lost River because all water is diverted from the lower 0.5 kilometer (0.3 mile) of the stream during summer months. If providing minimum stream flows is found to be feasible, providing adequate flows would reconnect the stream with the river.

1.2.3 Evaluate feasibility of reconnecting Williams Creek to the Little Lost River by providing adequate stream flows. Two diversions, one operated during spring through fall and the other operated during the winter, have completely dewatered the lower 2 to 3 kilometers (1.2 to 1.9 miles) of Williams Creek. The diversions have reduced habitat available to bull trout and prevented fish movement between Williams Creek and the Little Lost River. If providing minimum stream flows is found to be feasible, providing adequate flows would reconnect the Williams Creek with the Little Lost River and expand habitat available to bull trout.

1.2.4 Analyze culvert survey data collected by the Forest Service and develop a plan to address the culverts found to inhibit fish passage. The U.S. Forest Service has conducted a survey of culverts on National Forest lands in the Little Lost River basin. The data have not been analyzed to identify

culverts inhibiting fish passage. Specific culverts likely to be affecting bull trout are noted in additional recovery tasks.

1.2.5 Conduct survey of culverts on Bureau of Land Management and private lands and develop a plan to address culverts found to inhibit fish passage. A comprehensive survey to identify culverts that prevent or inhibit fish passage has not been conducted on Bureau of Land Management and private lands. Information generated from the survey should be used to develop a plan to address culverts that inhibit fish passage.

1.2.6 Evaluate fish passage at specific culverts on Timber Creek (U.S. Forest Service Road #105) and Redrock Creek (Forest Service Road #460) and modify or replace culverts, as necessary, to provide or improve fish passage. The two culverts may interfere with upstream movement of small fish. Necessary modifications should be made so that the culverts do not inhibit fish passage.

1.2.7 Evaluate fish passage at specific culverts on Jackson Creek and Hawley Creek (U.S. Forest Service Road #104 on both streams) and modify or replace culverts, as necessary, to provide or improve fish passage. The two culverts may interfere with upstream movement of fish. Necessary modifications should be made so that the culverts do not inhibit fish passage.

1.2.8 Evaluate fish passage at two culverts on the upper Little Lost River (U.S. Forest Service Road #101) and modify or replace the culverts, as necessary, to provide or improve fish passage. The two culverts may interfere with upstream movement of small fish. Necessary modifications should be made so that the culverts do not inhibit fish passage.

1.2.9 Remove artificial barrier on lower Camp Creek. A head-cut associated with a road crossing on Camp Creek appears to be a barrier to upstream fish movement. A restoration approach that is compatible with the surrounding stream channel should be developed and actions should be implemented to provide or improve fish passage.

1.2.10 Inventory diversions in the lower Little Lost River, evaluate entrainment and feasibility of eliminating or reducing entrainment, and implement appropriate actions. Numerous diversions occur on the lower Little Lost River (from the Summit Creek confluence downstream to the Little Lost River Sinks). The influence of the diversions on fish entrainment, movement, and habitat conditions is not known.

1.2.11 Evaluate bull trout loss at the flood-control structure near Howe and implement tasks to reduce negative effects. Bull trout may be lost in the diversion canals or trapped below the flood-control structure near Howe when in operation. Fish loss should be quantified and structural or operational approaches to prevent or reduce loss should be developed and implemented, consistent with terms and conditions in a recent biological opinion (USFWS 2002).

1.2.12 Evaluate potential of Moonshine Creek to support bull trout and provide passage if habitat is suitable for bull trout. Bull trout do not currently occur in Moonshine Creek, a tributary to the upper Little Lost River. Habitat may be suitable, but a culvert prevents fish access from the Little Lost River. If habitat is suitable, replace the culvert to allow bull trout access to Moonshine Creek. Expanding the habitat available to bull trout improves the likelihood of achieving recovery.

1.2.13 Evaluate barrier formed by debris, and perhaps a head-cut, on Bunting Canyon Creek and implement tasks to expand bull trout distribution upstream of the barrier. In Badger Creek, bull trout are restricted to a relatively short reach of the stream and to the lower 300 meters (984 feet) of Bunting Canyon Creek, to where debris and possibly a head-cut have created a 1-meter (3.3-feet) waterfall in the tributary. The waterfall prevents bull trout access to about 3 kilometers (1.9 miles) of apparently suitable habitat. A restoration approach that is compatible with the surrounding stream channel should be developed and implemented to provide fish passage and should include the introduction of bull trout upstream of the barrier. The intent of introductions is to expand bull trout distribution in this relatively small, currently isolated local population.

1.3 Identify impaired stream channel and riparian areas and implement tasks to restore their functions.

1.3.1 Evaluate effects of livestock grazing on bull trout egg incubation and on spawning and rearing habitat and adjust grazing strategy as appropriate. If grazing is found to be negatively affecting bull trout eggs and habitat (*e.g.*, through sediment production, streambank and channel instability), adjustments to grazing strategies (*e.g.*, improvements to cattle dispersal, timing of use, and herding) should be made to improve integrity of riparian vegetation. Areas on which to focus include Badger, Worm, Squaw, Mill, Iron, Timber, and Smithie Fork Creeks and the upper Little Lost River.

1.3.2 Relocate Mill Creek trailhead away from Mill Creek and rehabilitate the existing trailhead site. Disbursed recreation is probably affecting streambanks and riparian vegetation at the trailhead. Relocating the trailhead away from the stream

and rehabilitating the site will improve aquatic and riparian conditions.

1.3.3 Evaluate the effects of channelization on the middle portion of the Little Lost River (*i.e.*, the reach between the confluences of Iron and Summit Creeks) and develop and implement a strategy to restore a natural stream channel. Much of the Little Lost River between the National Forest boundary and Summit Creek has been channelized, which simplifies aquatic habitat and may increase water temperatures. Although channelized reaches are no longer maintained and are gradually returning to more natural conditions, the effects should be assessed so that activities can be developed and implemented to restore more natural conditions to the channelized reaches.

1.3.4 Evaluate habitat conditions in the lower portion of the Little Lost River (*i.e.*, the reach from the confluence of Summit Creek to the Little Lost River Sinks) and develop and implement a strategy to restore habitat conditions. Habitat in the lower portion of the Little Lost River has been altered by grazing, channelization, and dewatering, processes that have increased water temperatures and reduced the quality and amount of migratory, foraging, and overwintering habitat for bull trout. Operation of the flood-control structure near Howe seasonally dewaters the lowest 16.9 kilometers (10.5 miles) of the river. Habitat conditions in the reach should be assessed so that activities can be developed and implemented to restore more natural conditions to the lower river.

1.4 *Operate dams to minimize negative effects on bull trout in reservoirs and downstream.*

1.5 *Identify upland conditions that negatively affect bull trout habitats and implement tasks to restore appropriate functions*.

2 Prevent and reduce negative effects of nonnative fishes and other nonnative taxa on bull trout.

2.1 *Develop, implement, and enforce public and private fish stocking policies to reduce stocking of nonnative fishes that affect bull trout.*

2.2 Evaluate enforcement policies for preventing illegal transport and introduction of nonnative fishes.

2.2.1 Investigate the existence of brown trout in ponds on private lands and work with landowners to prevent introductions in streams. Brown trout have not been documented in the Little Lost River basin, but they have reportedly been caught in private ponds in the lower portion of the basin. If brown trout are found, work with landowners to prevent the species from becoming established and possibly negatively interacting bull trout.

2.3 *Provide information to the public about ecosystem concerns of illegal introductions of nonnative fishes*.

2.4 Evaluate biological, economic, and social effects of controlling nonnative fishes.

2.4.1 Evaluate feasibility of reducing or eliminating brook trout in Big Creek and implement appropriate actions. Brook trout provide a popular fishery but are thought to be responsible for the decline and possible extirpation of bull trout in Big Creek, a tributary of Wet Creek. Big Creek is an important area for bull trout in the Little Lost River Recovery Unit. A feasibility study and plan evaluating appropriate methods to

remove brook trout and to establish an alternative fishery (*e.g.*, sterile rainbow trout) should be conducted and implemented.

2.5 Implement control of nonnative fishes where found to be feasible and appropriate.

2.5.1 Assess feasibility of eradicating brook trout from the Wet Creek, Squaw Creek, and Mill Creek drainages. Interactions (*e.g.*, competition, predation, and hybridization) with brook trout are factors that negatively affect bull trout in the three drainages. The feasibility of removing brook trout needs to be evaluated and an appropriate program to eradicate brook trout implemented.

2.6 Develop tasks to reduce negative effects of nonnative taxa on bull trout.

2.6.1 Assess feasibility of temporally installing fish barriers above the upper limit of brook trout distribution in Wet, Squaw, and Mill Creeks. Brook trout appear to be expanding their distribution into areas occupied by bull trout in the three drainages. The use of fish barriers to inhibit brook trout movement should be evaluated as an interim protection measure for bull trout, while work is conducted on methods to eradicate brook trout. Actions developed from this evaluation should be designed to minimally inhibit movement of bull trout.

2.6.2 Monitor the lower portions of Badger and Williams Creeks for brook trout if barriers to fish passage with the Little Lost River are corrected. Brook trout may invade the two streams if passage is reestablished with the Little Lost River. Actions

to prevent brook trout invasion should be implemented if monitoring detects brook trout.

2.6.3 Monitor the lower portions of Warm, Iron, Timber, and Smithie Fork Creeks and the upper Little Lost River for brook trout. Brook trout do not currently occur in the streams, but no known physical barriers prevent their invasion. Actions to prevent brook trout invasion should be implemented if monitoring detects brook trout.

3 Establish fisheries management goals and objectives compatible with bull trout recovery and implement practices to achieve goals.

3.1 Develop and implement State and Tribal native fish management plans integrating adaptive research.

3.2 Evaluate and prevent overharvest and incidental angling mortality of bull trout.

3.2.1 Evaluate effects of fishing (*e.g.*, illegal harvest, hooking mortality) on bull trout and implement appropriate actions (*e.g.*, providing information to anglers, enforcing regulations, revising regulations) to reduce any negative effects. Fishing may be negatively affecting bull trout through such factors as anglers misidentifying fish, mishandling fish, and not complying with regulations. Factors associated with fishing should be evaluated, and actions to reduce any negative effects, such as increasing enforcement, initiating angler education programs, and revised regulations, should be implemented. Areas for focusing efforts include the entire Little Lost River (upper, middle, and lower portions), Wet Creek, Timber Creek, and Smithie Fork Creek.

3.3 Evaluate potential effects of introduced fishes and associated sport fisheries on bull trout recovery and implement tasks to minimize negative effects on bull trout.

3.4 Evaluate effects of existing and proposed sport fishing regulations on bull trout.

4 Characterize, conserve, and monitor genetic diversity and gene flow among local populations of bull trout.

4.1 Incorporate conservation of genetic and phenotypic attributes of bull trout into recovery and management plans.

4.1.1 Collect samples for genetic analysis to contribute to establishing a program to understand the genetic baseline and monitor genetic changes throughout the range of bull trout. (See Chapter 1 narrative.)

4.1.2 Describe and monitor genetic and phenotypic characteristics of bull trout and incorporate information into management strategies. The interaction of the genetic composition of bull trout with particular environments results in phenotypic diversity and perhaps local adaption. Such information for particular groups of bull trout and their habitats should be generated and incorporated into management strategies to improve their effectiveness.

4.2 Maintain existing opportunities for gene flow among bull trout populations.

4.2.1 Prevent the establishment of barriers that may inhibit the movement of bull trout within the Little Lost River Recovery Unit (*e.g.*, structural barriers or unsuitable habitat conditions) and investigate additional opportunities to improve passage.

Some construction and land management activities may create barriers that inhibit bull trout movement. Activities that may potentially create barriers should be altered so that bull trout movement is not impeded. The possibility of using barriers to restrict brook trout movement (task 2.6.1) is the subject of an evaluation and using such barriers is intended to be temporary while a study is conducted.

4.3 Develop genetic management plans and guidelines for appropriate use of transplantation and artificial propagation.

5 Conduct research and monitoring to implement and evaluate bull trout recovery activities, consistent with an adaptive management approach using feedback from implemented, site-specific recovery tasks.

5.1 Design and implement a standardized monitoring program to assess the effectiveness of recovery efforts affecting bull trout and their habitats.

5.2 Conduct research evaluating relationships among bull trout distribution and abundance, bull trout habitat, and recovery tasks.

5.3 Conduct evaluations of the adequacy and effectiveness of current and past best management practices in maintaining or achieving habitat conditions that are conducive to bull trout recovery.

5.4 Evaluate effects of diseases and parasites on bull trout and develop and implement strategies to minimize negative effects.

5.5 Develop and conduct research and monitoring studies to improve information concerning the distribution and status of bull trout.

5.5.1 Collect and analyze information on size, age, and maturation of bull trout to evaluate estimates of adult-size fish. For

purposes of abundance estimates, bull trout of 180 millimeters (7 inches) total length are considered to be adults. This value is based on scale analyses (*i.e.*, length–age data) from about 85 bull trout collected in the Little Lost River and tributaries during 1985. Additional information is needed to evaluate the estimates and to revise the estimates, if necessary.

5.5.2 Investigate habitat conditions in Wet Creek during winter. Recent declines in bull trout abundance in Wet Creek are thought to be related to severe winter conditions exacerbated by drought and degraded habitat (*e.g.*, reduced riparian vegetation). A study investigating habitat and the role of winter conditions on bull trout abundance should be conducted to improve understanding of bull trout declines and to initiate actions to reduce potential negative effects.

5.6 Identify evaluations needed to improve understanding of relationships among genetic characteristics, phenotypic traits, and local populations of bull trout.

6 Use all available conservation programs and regulations to protect and conserve bull trout and bull trout habitats.

6.1 Use partnerships and collaborative processes to protect, maintain, and restore functioning core areas for bull trout.

6.1.1 As appropriate, protect and restore private lands to benefit bull trout by using cooperative processes such as easements, land exchanges, Conservation Reserve Programs, and cost sharing. Some habitats important for bull trout recovery, especially migratory, foraging, and overwintering habitat, occur on private lands. Some may need protection to maintain conditions conducive to bull trout recovery,

whereas others may require restoration to reestablish adequate conditions. A variety of cooperative arrangements should be made with landowners to protect and restore habitats on private lands. Areas of focus should include Badger Creek, Wet Creek, and the middle and lower reaches of the Little Lost River.

6.2 Use existing Federal authorities to conserve and restore bull trout.

6.3 Enforce existing Federal, State, and Tribal habitat protection standards and regulations and evaluate their effectiveness for bull trout conservation.

7 Assess the implementation of bull trout recovery by recovery units and revise recovery unit plans based on evaluations.

7.1 Convene annual meetings of each recovery unit team to review progress on recovery plan implementation.

7.2 Assess effectiveness of recovery efforts.

7.3 Revise scope of recovery as suggested by new information.

IMPLEMENTATION SCHEDULE

The Implementation Schedule that follows lists recovery task priorities; task numbers; task descriptions; duration of tasks; potential or participating responsible parties; total cost estimate and estimates for the next five years, if available; and comments. The tasks, when accomplished, will lead to recovery of bull trout in the Little Lost River Recovery Unit. Cost estimates are not provided for tasks that are normal agency responsibility under existing authorities.

Parties with authority, responsibility, or expressed interest to implement a specific recovery task are identified in the Implementation Schedule. The appearance of a responsible party in the table does not imply that prior approval has been given or require that party to participate or expend any funds. However, willing participants will benefit by demonstrating that their budget submission or funding request is for a recovery task identified in an approved recovery plan and is, therefore, part of a coordinated recovery effort to recover bull trout. In addition, section 7 (a)(1) of the Endangered Species Act directs all Federal agencies to use their authorities to further the purposes of the Endangered Species Act by implementing programs for conservation of threatened or endangered species.

The following are definitions to column headings in the Implementation Schedule:

Priority Number: All priority 1 tasks are listed first, followed by priority 2 and priority 3 tasks.

Priority 1: All actions that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.

Priority 2: All actions that must be taken to prevent a significant decline in species population or habitat quality or to prevent some other significant negative effect short of extinction.

Priority 3: All other actions necessary to provide for full recovery (or reclassification) of the species.

Task Number and Task Description: Recovery tasks are numbered as in the recovery outline. Refer to the action narrative for task descriptions.

Task Duration: Expected number of years to complete the corresponding task. Study designs can incorporate multiple tasks, which, when combined, may reduce the time needed for task completion.

Responsible or Participating Party: The following organizations are those with responsibility or capability to fund, authorize, or carry out the corresponding recovery task:

Federal agencies:

BLM	Bureau of Land Management
NRCS	Natural Resources Conservation Service
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service

State agencies:

IDEQ	Idaho Department of Environmental Quality
IDFG	Idaho Fish and Game
IDWR	Idaho Department of Water Resources

Bolded type indicates the agency or agencies that have the lead role for task implementation and coordination, though not necessarily sole responsibility.

Cost Estimates: Cost estimates are rough estimates and are only provided for general guidance. Total costs are estimated for the duration of the task, are itemized annually for the next five years, and includes estimates of expenditures by local, Tribal, State, and Federal governments and private business and individuals.

An asterisk (*) in the total cost column indicates ongoing tasks that are currently being implemented as part of normal agency responsibilities under existing authorities. Because these tasks are not being done specifically or solely for bull trout conservation, they are not included in the cost estimates. Some of these efforts may be occurring at reduced funding levels and/or in only a small portion of the watershed.

Double asterisk (**) in the total cost column indicates that estimated costs for these tasks are not determinable at this time. Input is requested to help develop reasonable cost estimates for these tasks.

Triple asterisk (***) indicates costs are combined with or embedded within other related tasks.

Implementation schedule for the bull trout recovery plan: Little Lost River Recovery Unit											
Priority number	Task number	Task description	Task duration (years)	Responsible parties (Alphabetical)	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
1	1.1.1	Develop and implement a management strategy to reduce sediment levels on National Forest and private lands in the Badger Creek watershed	Perpetual	landowners, **IDEQ, NRCS,** USFWS, **USFS**	10	10					Ongoing[1], cost estimate for strategy development.
1	1.1.3	Develop and implement a management strategy to reduce sediment levels in bull trout spawning and rearing habitat in the Wet Creek watershed	Perpetual	**IDEQ, USFS**	*						Ongoing
1	1.2.1	Provide upstream fish passage at the Badger Creek water diversion	Perpetual	**diversion operator, NRCS**, USFS	15	15					Cost estimate for construction to provide passage in perpetuity.
1	1.2.2	Assess feasibility of providing minimum stream flows between the Badger Creek diversion and the Little Lost River	1	**diversion operator**, **IDFG**, IDWR, NRCS, **USFWS**	10	10					Cost estimate for feasibility study.

[1]Ongoing tasks are currently being implemented as part of normal agency responsibilities that may benefit bull trout. Because these actions are not specifically being done to address bull trout conservation, they are not included in the cost estimates. Some of these efforts may be occurring at reduced funding levels and/or in only a small portion of the watershed.

Implementation schedule for the bull trout recovery plan: Little Lost River Recovery Unit											
Priority number	Task number	Task description	Task duration (years)	Responsible parties (Alphabetical)	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
1	1.2.3	Evaluate feasibility of reconnecting Williams Creek to the Little Lost River by providing adequate stream flows	1	**diversion operator,** BLM, **IDFG,** IDWR, NRCS, **USFWS**	10	10					Cost estimate for feasibility study.
1	1.2.4	Analyze culvert survey data collected by the Forest Service and develop plan to address culverts found to inhibit fish passage	1	**USFS**	20	20					
1	1.2.5	Conduct survey of culverts on Bureau of Land Management and private lands and develop plan to address culverts found to inhibit fish passage	3	**BLM, IDFG**	120	40	40	40			Cost estimate for survey and feasibility study.
1	1.2.10	Inventory diversions in the lower Little Lost River, evaluate entrainment and feasibility of eliminating or reducing entrainment, and implement appropriate actions	1	BLM, **IDFG, IDWR**, NRCS, USFWS	100	50	50				Cost estimate for inventory and feasibility study.
1	1.2.11	Evaluate bull trout loss at the flood-control structure near Howe and implement tasks to reduce negative effects	3	**BLM**, IDFG, NRCS, USFWS	150	50	50	50			Cost estimate for evaluation and feasibility study.

Implementation schedule for the bull trout recovery plan: Little Lost River Recovery Unit											
Priority number	Task number	Task description	Task duration (years)	Responsible parties (Alphabetical)	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
1	1.2.13	Evaluate barrier formed by debris, and perhaps a head-cut, on Bunting Canyon Creek and implement tasks to expand bull trout distribution upstream of the barrier	1	IDFG, **USFS**	20	20					Cost estimate for evaluation to develop restoration approach.
1	1.3.1	Evaluate effects of livestock grazing on bull trout egg incubation and on spawning and rearing habitat and adjust grazing strategy as appropriate	Perpetual	IDFG, USFWS, **USFS**	*						
1	1.3.3	Evaluate the effects of channelization on the middle portion of the Little Lost River (*i.e.*, the reach between the confluences of Iron and Summit Creeks) and develop and implement a strategy to restore a natural stream channel	Perpetual	**BLM**, IDFG, USFWS	50	50					Cost estimate for feasibility study.
1	1.3.4	Evaluate habitat conditions in the lower portion of the Little Lost River (*i.e.*, the reach from the confluence of Summit Creek to the Little Lost River Sinks) and develop and implement a strategy to restore habitat conditions	Perpetual	IDFG, **NRCS,** USFWS	50	50					Cost estimate for feasibility study.
1	2.4.1	Evaluate feasibility of reducing or eliminating brook trout in Big Creek and implement appropriate actions	3	BLM, **IDFG**, USFWS, USFS	90	30	30	30			Cost estimate for feasibility study.

Implementation schedule for the bull trout recovery plan: Little Lost River Recovery Unit											
Priority number	Task number	Task description	Task duration (years)	Responsible parties (Alphabetical)	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
1	2.5.1	Assess feasibility of eradicating brook trout from the Wet Creek, Squaw Creek, and Mill Creek drainages	3	BLM, **IDFG,** USFWS, USFS	180	60	60	60			Cost estimate for feasibility study.
1	2.6.1	Assess feasibility of temporally installing fish barriers above the upper limit of brook trout distribution in Wet, Squaw, and Mill Creeks	3	IDFG, USFWS, **USFS**	30	10	10	10			Coordinate with task 2.5.1.
1	2.6.2	Monitor the lower portions of Badger and Williams Creeks for brook trout if barriers to fish passage with the Little Lost River are corrected	Coincident with permitted grazing.	BLM, **IDFG**	110	5	5	5	5	5	Contingent on tasks 1.2.1 and 1.2.3. Assumed 25 years of implementation.
1	4.2.1	Prevent the establishment of barriers that may inhibit the movement of bull trout within the Little Lost River Recovery Unit (*e.g.*, structural barriers or unsuitable habitat conditions) and investigate additional opportunities to improve passage	25	**BLM, IDFG, NRCS,** USFWS, **USFS**	110	5	5	5	5	5	Ongoing, cost estimates to investigate additional opportunities to improve passage.
1	5.5.2	Investigate habitat conditions in Wet Creek during winter	3	BLM, IDFG, **USFS**	60	20	20	20			Repeat as include range of winter conditions.

Implementation schedule for the bull trout recovery plan: Little Lost River Recovery Unit											
Priority number	Task number	Task description	Task duration (years)	Responsible parties (Alphabetical)	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
1	6.1.1	As appropriate, protect and restore private lands to benefit bull trout by using cooperative processes such as easements, land exchanges, Conservation Reserve Programs, and cost sharing	Perpetual	**BLM, IDFG,** landowners, **NRCS, USFWS, USFS**	*						Ongoing
2	1.1.2	Reduce sediment from roads and trails in the Iron Creek and Timber Creek watersheds	5	**USFS**	50	10	10	10	10	10	
2	1.2.6	Evaluate fish passage at specific culverts on Timber Creek (U.S. Forest Service Road #105) and Redrock Creek (Forest Service Road #460) and modify or replace culverts, as necessary, to provide or improve fish passage	2	**USFS**	20	10	10				Cost estimate for evaluation. Implementation cost dependent on specific action taken.
2	1.2.7	Evaluate fish passage at specific culverts on Jackson Creek and Hawley Creek (U.S. Forest Service Road #104 on both streams) and modify or replace culverts, as necessary, to provide or improve fish passage	2	**USFS**	20	10	10				Cost estimate for evaluation. Implementation cost dependent on specific action taken.
2	1.2.8	Evaluate fish passage at two culverts on the upper Little Lost River (U.S. Forest Service Road #101) and modify or replace the culverts, as necessary, to provide or improve fish passage	2	**USFS**	20	10	10				Cost estimate for evaluation. Implementation cost dependent on specific action taken.

Implementation schedule for the bull trout recovery plan: Little Lost River Recovery Unit											
Priority number	Task number	Task description	Task duration (years)	Responsible parties (Alphabetical)	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
2	1.2.9	Remove artificial barrier on lower Camp Creek	2	**USFS**	20	10	10				Cost estimate for evaluation. Implementation cost dependent on specific action taken.
2	1.3.2	Relocate Mill Creek trailhead away from Mill Creek and rehabilitate the existing trailhead site	1	**USFS**	20	20					
2	2.6.3	Monitor the lower portions of Warm, Iron, Timber, and Smithie Fork Creeks and the upper Little Lost River for brook trout	Perpetual	IDFG, **USFS**	*						Ongoing
2	3.2.1	Evaluate effects of fishing (*e.g.*, illegal harvest, hooking mortality) on bull trout and implement appropriate actions (*e.g.*, providing information to anglers, enforcing regulations, revising regulations) to reduce any negative effects	Perpetual	**IDFG,** USFWS	*						Ongoing
3	1.2.12	Evaluate potential of Moonshine Creek to support bull trout and provide passage if habitat is suitable for bull trout	1	**USFS**	10	10					Cost estimate for evaluation study.

Implementation schedule for the bull trout recovery plan: Little Lost River Recovery Unit											
Priority number	Task number	Task description	Task duration (years)	Responsible parties (Alphabetical)	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
3	2.2.1	Investigate the existence of brown trout in ponds on private land and work with landowners to prevent introductions in streams	1	**IDFG**	10	10					
3	4.1.1	Collect samples for genetic analysis to contribute to establishing a program to understand the genetic baseline and monitor genetic changes throughout the range of bull trout	25	**BLM, IDFG, USFS**	25	1	1	1	1	1	Ongoing, conducted in conjunction with existing monitoring activities.
3	4.1.2	Describe and monitor genetic and phenotypic characteristics of bull trout and incorporate information into management strategies	25	**BLM, IDFG, USFWS, USFS**	***						Ongoing, coordinate with task 4.1.1.
3	5.5.1	Collect and analyze information on size, age, and maturation of bull trout to evaluate estimates of adult-size fish	25	**BLM, IDFG, USFWS, USFS**	25	1	1	1	1	1	Conducted in conjunction with existing monitoring activities

REFERENCES CITED

Batt, Governor P. E. 1996. State of Idaho bull trout conservation plan. Boise, Idaho.

Behnke, R. 1992. Native trout of western North America. American Fisheries Society Monograph 6.

(BLM) U.S. Bureau of Land Management. 1979. Little Lost–Birch Creek range management environmental statement. BLM, Idaho Falls District, Big Butte Resource Area, Idaho Falls, Idaho.

(BLM) U.S. Bureau of Land Management. 1981. Little Lost–Birch Creek management framework plan (MFP). Land use decision summary. BLM, Idaho Falls District, Big Butte Resource Area, Idaho Falls, Idaho.

(BLM) U.S. Bureau of Land Management. 1997. Lower Sawmill Creek watershed analysis. BLM, Idaho Falls Field Office, Idaho Falls, Idaho. December.

(BLM and USFS) U.S. Bureau of Land Management and U.S. Forest Service. 1998. Biological assessment for bull trout in the Little Lost River watershed. 1998 draft.

Corsi, C., and Elle, S. 1986. Regional fisheries management investigations. Region 6 streams and rivers investigations. Job performance report. Project F-71-R-10, Job VI-c. Idaho Department of Fish and Game.

Corsi, C., and S. Elle. 1989. Regional fisheries management investigations. Region 6 rivers and streams investigations—Big Lost and Little Lost Rivers, and Birch and Medicine Lodge Creek survey. Job performance report. Project F-71-R-12, Job No. 6 (IF)-c^2. Idaho Department of Fish and Game.

Corsi, C., B. Spateholts, V. Moore, and T. Williams. 1986. Regional fishery management investigations. Region 6 stream investigations. Job performance report. Project F-73-R-8, Job No. VI-c. Idaho Department of Fish and Game.

Crow, J.F., and M. Kimura. 1970. An introduction to population genetics theory. Harper and Row, New York.

Elle, S., C. Corsi, and D. Aslett. 1987. Regional fisheries management investigations. Region 6 rivers and streams investigations. Job Performance Report. Project F-71-R-11, Job No. 6(IF)-c^2. Idaho Department of Fish and Game.

Franklin, I.R. 1980. Evolutionary changes in small populations. *In*: M.E. Soule and B.A. Wilcox, editors. Conservation biology: an evolutionary-ecological perspective. Sinauer Associates, Sunderland, Massachusetts. p. 135-149.

Gamett, B.L. 1999. The history and status of fishes in the Little Lost River drainage, Idaho. Lost River Ranger District, Salmon-Challis National Forest; Upper Snake Region, Idaho Department of Fish and Game; Idaho Falls District, Bureau of Land Management; Sagewillow, Inc. May.

(IDEQ) Idaho Division of Environmental Quality. 1998a. Little Lost River subbasin assessment. Idaho Department of Health and Welfare, Division of Environmental Quality. From IDEQ web site for Little Lost River TMDL at http://www2.state.id.us/deq/water/tmdls/lostriver/lostriver_tmdl.shtm.

(IDEQ) Idaho Division of Environmental Quality. 1998b. Idaho's 1998 303(d) list. Available at http://www2.state.id.us/deq/water/1998_303d/303dlist.pdf.

Lande, R. 1988. Genetics and demography in biological conservation. Science 241:1455-1460.

(LLRITAT) Little Lost River Interagency Technical Advisory Team. 1998. Little Lost River key watershed bull trout problem assessment. Prepared for the State of Idaho. June 29.

Meffe, G.K., and C.R. Carroll. 1994. Principles of conservation biology. Sinauer Associates, Inc. Sunderland, Massachusetts.

Rieman, B.E., and F.W. Allendorf. 2001. Effective population size and genetic conservation criteria for bull trout. North American Journal of Fisheries Management 21:756-764.

Rieman, B.E., and J.D. McIntyre. 1993. Demographic and habitat requirements for conservation of bull trout. General Technical Report INT-302. U.S. Forest Service, Intermountain Research Station.

Soule, M. E. 1980. Thresholds for survival: maintaining fitness and evolutionary potential. *In*: M.E. Soule and B.A. Wilcox, editors. Conservation biology: an evolutionary-ecological perspective. Sinauer and Associates, Sunderland, Massachusetts. p. 151-170.

(USFWS) U.S. Fish and Wildlife Service. 1998. Klamath River and Columbia River bull trout population segments: status summary and supporting documents lists. Prepared by bull trout listing team. Boise, Idaho.

(USFWS) U.S. Fish and Wildlife Service. 1999. Section 7 consultation—Little Lost River subpopulation Columbia River bull trout biological opinion. Snake River Basin Office, Boise, Idaho. April 27.

(USFWS) U.S. Fish and Wildlife Service. 2002. Section 7 consultation—Little Lost River flood control project biological opinion. Snake River Basin Office, Boise, Idaho. March 5.

(USFS) U.S. Forest Service. 1999. Results of aquatic monitoring for National Forests lands in the Little Lost River, Idaho drainage. Lost River Ranger District, Salmon-Challis Nation Forest. December 22.

Personal Communications

Koelsch, P., Bureau of Land Management. 2001. Comments made on draft Little Lost River Recovery Unit chapter, submitted to S. Lohr, U.S. Fish and Wildlife Service. Dated July 26.

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Stream	Location	Sampling Method	Date	Length	Width	Water Temp °C	Total Captured ≥70 mm (all fish)[a]	Population Estimate (Range)	Fish/ 100 mm^2	Rb	Bk	Bl	Sculpin Present	Comments
Badger Creek #1	3.2 km above Little Lost River	1 pass	9/95	52	2.5	6	4 (4)	- -	- -	100	- -	- -	yes	
Badger Creek #2	1.4 km above Forest boundary	1 pass	9/95	96	2.4	6	12 (14)	- -	- -	92	- -	8	no	
Badger Creek #3	0.3 km above Bunting Canyon Ck	2 pass 2 pass	7/97 6/95	20 20	1.8 1.4	7 7	16 (19) 17 (18)	16 (16-18) 17 (17-18)	44.4 64.1	100 94	- - - -	- - 6	no no	
Big Creek #1	0.8 km above Wet Creek	1 pass 2 pass	9/96 8/94	68 95	2.2 2.1	11 - -	7 (14) 16	- - 16 (16-17)	- - 8.0	86 81	14 19	- - - -	yes - -	
Big Creek #1a	20 m above Forest boundary	1 pass	9/96	54	2.4	10	30 (36)	- -	- -	37	63	- -	yes	
Big Creek #2	at trailhead	2 pass	9/94	88	2.2	- -	54	65 (56-75)	33.6	52	48	- -	- -	

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Stream	Location	Sampling Method	Date	Length	Width	Water Temp °C	Total Captured ≥70 mm (all fish)[a]	Population Estimate (Range)	Fish/ 100 mm^2	Rb	Bk	Bl	Sculpin Present	Comments
Big Creek #3	immediatel y below beaver pond	2 pass	8/94	91	4.0	- -	123	154 (138-170)	42.3	60	38	2	- -	1 fish appeared to be a Bk-Bl hybrid
Big Creek #4	above beaver pond	2 pass	9/94	73	1.6	- -	125	160 (142-179)	137	18	77	6	- -	all bull trout appeared to be Bk-Bl hybrids
Bunting Canyon #1	175 m above Badger Creek	1 pass	7/97	43	1.6	6	6 (9)	- -	- -	50	- -	50	no	
Bunting Canyon #2	0.8 km above Badger Creek	1 pass	6/95	60[b]	1.5[b]	- -	none observed	- -	- -	- -	- -	- -	no	included 2 separate sections
Bunting Canyon #3	2 km above Badger Creek	1 pass	6/95	50[b]	1.0[b]	- -	none observed	- -	- -	- -	- -	- -	no	
Camp #1 (Sawmill Canyon)	100 m above Timber Creek	1 pass	9/95	25	1.2	7	5 (5)	- -	- -	- -	- -	100	no	

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Stream	Location	Sampling Method	Date	Length	Width	Water Temp °C	Total Captured ≥70 mm (all fish)[a]	Population Estimate (Range)	Fish/ 100 mm^2	Rb	Bk	Bl	Sculpin Present	Comments
Camp #2 (Sawmill Canyon)	1.6 km above Timber Creek	1 pass/ visual	9/95	10[b]	1.0[b]	- -	none observed	- -	- -	- -	- -	- -	no	habitat limited
Firebox Creek	400 m above Little Lost River	2 pass	7/97	100	2.9	8	36 (41)	48 (36-72)	16.6	- -	- -	100	no	
Hawley Creek	immediatel y above Iron Creek Road	1 pass	9/95	47	0.8	5	1 (1)	- -	- -	- -	- -	100	no	habitat limited
Iron Creek	just above Iron Creek Road	1 pass 2 pass	9/96 8/95	88 93	2.2 2.2	5 9	4 (8) 14 (14)	- - 20 (14-31)	- - 10.1	- - - -	- - - -	100 100	no no	
Jackson Creek	just above Iron Creek Road	1 pass	9/95	73	2.1	3	2 (2)	- -	- -	- -	- -	100	no	habitat limited
Little Lost #1 (BLM)	0.8 km below Big Springs Creek	1 pass	9/93	144	6.7	- -	6	- -	- -	100	- -	- -	- -	

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Stream	Location	Sampling Method	Date	Length	Width	Water Temp °C	Total Captured ≥70 mm (all fish)[a]	Population Estimate (Range)	Fish/ 100 mm^2	Rb	Bk	Bl	Sculpin Present	Comments
Little Lost #2 (BLM)	0.4 km below Buck and Bird Road	2 pass	9/93	208	4.7	- -	12	16 (12-23)	1.6	92	- -	8	- -	
Little Lost #3 (BLM)	at Clyde Campground	2 pass	9/93	234	7.1	- -	125	238 (158-318)	14.3	96	1	3	- -	
Little Lost #4 (BLM Sawmill #4)	lower end of lower pasture	2 pass 2 pass	7/97 8/93	108 105	7.2 5.0	20 - -	14 (14) 14	14 (14-16) 14 (14-14)	1.8 2.7	71 93	14 7	14 - -	no - -	
Little Lost #5 (BLM Sawmill #3)	above Mahogany Creek Road crossing	2 pass 2 pass	7/97 8/93	131 109	8.6 5.0	17 - -	24 (24) 10	25 (24-28) 11 (10-12)	2.2 2.0	75 70	8 20	17 10	yes - -	
Little Lost #6 (BLM Sawmill #2)	lower portion of upper exclosure	2 pass 2 pass	7/97 8/93	131 94	7.2 7.7	14 - -	27 (27) 42	33 (27-46) 48 (42-59)	3.5 6.6	93 93	- - 2	7 5	yes - -	

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Stream	Location	Sampling Method	Date	Length	Width	Water Temp °C	Total Captured ≥70 mm (all fish)[a]	Population Estimate (Range)	Fish/ 100 mm^2	Rb	Bk	Bl	Sculpin Present	Comments
Little Lost #7 (BLM Sawmill #1)	2.4 km below Sawmill Canyon Rd	2 pass 2 pass	7/97 8/93	110 110	7.2 7.3	10 - -	40 (40) 43	45 (40-54) 56 (44-68)	5.7 7.0	90 91	8 9	3 - -	yes - -	
Little Lost #8 (FS Sawmill #1)	at Forest boundary	2 pass 4 pass	7/97 9/95	182 126	9.3 8.5	11 13	63 (63) 104 (105)	71 (63-83) 120 (104-136)	4.2 11.2	92 93	3 4	5 3	no no	1 fish appeared to be a Bk-Bl hybrid (’97)
Little Lost #9 (FS Sawmill #2)	behind Guard Station	2 pass 3 pass	7/97 9/95	158 162	9.2 7.6	11 7	75 (79) 97 (97)	93 (75-117) 99 (97-102)	6.4 8.0	87 93	11 4	3 3	- - no	2 fish appeared to be Bk-Bl hybrids (’97)
Little Lost #10 (FS Sawmill #3)	above Mill Creek	2 pass 3 pass	7/97 9/95	112 103	7.8 5.7	12 12	62 (62) 52 (52)	84 (62-117) 53 (52-55)	9.6 9.0	65 79	35 15	- - 6	yes yes	some fish appeared to be Bk-Bl hybrids (’97)
Little Lost #10a (FS Sawmill #3a)	10 m above Iron Creek Road	1 pass 1 pass	8/97 9/96	100 91	9.1 8.4	13 6	31 (34) 29 (30)	- - - -	- - - -	39 66	3 - -	58 34	yes yes	

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Stream	Location	Sampling Method	Date	Length	Width	Water Temp °C	Total Captured ≥70 mm (all fish)[a]	Population Estimate (Range)	Fish/ 100 mm^2	Rb	Bk	Bl	Sculpin Present	Comments
Little Lost #11 (FS Sawmill #4)	0.4 km below Timber Creek	2 pass 2 pass	7/97 9/95	123 122	8.1 8.3	12 8	25 (28) 26 (26)	45 (25-104) 36 (26-48)	4.5 3.6	48 65	- - - -	52 35	yes yes	
Little Lost #12 (FS Sawmill #5)	0.8 km above Moonshine Creek	2 pass 3 pass	7/97 8/95	114 116	5.3 5.5	13 6	45 (46) 27 (27)	49 (45-56) 29 (27-33)	8.1 4.6	13 26	- - - -	87 74	yes no	
Little Lost #13 (FS Sawmill #6)	1.6 km above Smithie Fork	2 pass	8/95	83	3.0	- -	26 (27)	51 (26-88)	20.4	- -	- -	100	no	
Little Lost #14 (FS Sawmill #7)	400 m above Firebox Creek	1 pass	7/97	90	2.4	10	22 (26)	- -	- -	- -	- -	100	no	
Mill Creek #1	at Mill Creek Campground	2 pass 2 pass	8/97 8/95	73 70	4.1 3.6	8 10	54 (57) 42 (44)	62 (54-74) 50 (43-57)	20.7 20.0	3 12	93 52	4 36	no no	some fish appeared to be Bk-Bl hybrids (’95 &’97)

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Stream	Location	Sampling Method	Date	Length	Width	Water Temp °C	Total Captured ≥70 mm (all fish)[a]	Population Estimate (Range)	Fish/ 100 mm^2	Rb	Bk	Bl	Sculpin Present	Comments
Mill Creek #2	0.5 km above trailhead	1 pass	9/96	68	4.2	6	6 (6)	- -	- -	- -	67	33	no	3 fish appeared to be Bk-Bl hybrids, 1 rainbow trout was observed but uncaptured
Mill Creek #3	upstream from Mill Creek Lake	visual	8/95	50[b]	1.0[b]	- -	none observed	- -	- -	- -	- -	- -	- -	
Mill Creek, unnamed tributary 0.5 km above trailhead	50 m above Mill Creek	1 pass	9/96	25[b]	0.5[b]	- -	none observed	- -	- -	- -	- -	- -	no	habitat limited
Quigley Creek #1	25 m above Sawmill Canyon Rd	1 pass	6/97	21	0.8	10	1 (1)	- -	- -	- -	- -	100	no	
Quigley Creek #2	200 m above Sawmill Canyon Rd	1 pass	6/97	87	1.2	8	none observed	- -	- -	- -	- -	- -	no	

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Stream	Location	Sampling Method	Date	Length	Width	Water Temp °C	Total Captured ≥70 mm (all fish)[a]	Population Estimate (Range)	Fish/ 100 mm^2	Rb	Bk	Bl	Sculpin Present	Comments
Redrock Creek #1	0.2 km above Timber Creek	1 pass	9/95	42	1.9	6	8 (8)	- -	- -	- -	- -	100	no	
Redrock Creek #2	top end of transect is culvert on road 460A	1 pass	6/97	90	3.3	9	10 (10)	- -	- -	- -	- -	100	no	
Redrock Creek, Right Fork	400 m above Left Fork	1 pass	6/97	52	1.2	9	none observed	- -	- -	- -	- -	- -	no	
Redrock Creek, Left Fork	200 m above Right Fork	1 pass	6/97	56	1.0	9	none observed	- -	- -	- -	- -	- -	no	
Slide Creek #1	100 m above Timber Creek	1 pass	6/97	107	2.7	6	8 (8)	- -	- -	- -	- -	100	no	
Slide Creek #2	0.9 km above Timber Creek	1 pass	6/97	65	1.8	6	none observed	- -	- -	- -	- -	- -	no	

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Stream	Location	Sampling Method	Date	Length	Width	Water Temp °C	Total Captured ≥70 mm (all fish)[a]	Population Estimate (Range)	Fish/ 100 mm^2	Rb	Bk	Bl	Sculpin Present	Comments
Smithie Fork #1	just above Sawmill Road bridge	2 pass 2 pass	7/97 8/95	79 71	3.3 4.2	7 12	68 (69) 75 (77)	74 (68-83) 83 (77-89)	20.1 28.4	3 7	- - - -	97 93	no no	mean width does not include side channel that was included in transect
Smithie Fork #2	3.2 km above Little Lost River	2 pass	8/95	126	3.4	9	89 (92)	130 (102-158)	30.3	- -	- -	100	no	
Smithie Fork Trib. (unnamed)	200 m above confluence	1 pass	9/97	45	1.5	9	1 (1)	- -	- -	- -	- -	100	no	
Squaw Creek #1 (Sawmill Canyon)	0.8 km above Sawmill Canyon Rd	1 pass	9/96	55	3.3	11	27 (34)	- -	- -	33	52	15	yes	
Squaw Creek #2 (Sawmill Canyon)	4.0 km above Sawmill Road	2 pass 3 pass	7/97 8/95	56 66	2 3.3	9 10	27 (40) 26 (29)	27 (27-28) 27 (26-29)	24.1 12.3	41 23	48 58	11 19	no no	some fish appeared to be Bk-Bl hybrids (’95 & ’97)
Squaw Creek #3 (Sawmill Canyon	0.9 km above North Fork	1 pass	8/96	50	0.9	9	12 (19)	- -	- -	- -	- -	100	no	

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Stream	Location	Sampling Method	Date	Length	Width	Water Temp °C	Total Captured ≥70 mm (all fish)[a]	Population Estimate (Range)	Fish/ 100 mm^2	Rb	Bk	Bl	Sculpin Present	Comments
Squaw Creek, North Fork #1 (Sawmill Canyon)	0.6 km above Squaw Creek	1 pass	9/96	57	1.7	10	9 (12)	- -	- -	- -	56	44	no	
Squaw Creek, North Fork #2 (Sawmill Canyon)	1.8 km above Squaw Creek	1 pass	6/97	114	1.8	6	8 (8)	- -	- -	- -	13	88	no	
Squaw Creek, unnamed tributary (Sawmill Canyon)	tributary above Squaw Creek #2 on south side of road	1 pass	8/95	47	0.9	9	3 (3)	- -	- -	33	67	- -	no	
Summit Creek #1 (BLM #3)	4.0 km below Sawmill Road	2 pass	8/92	97	1.8	- -	23	28 (23-35)	16.0	91	9	- -	- -	

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Stream	Location	Sampling Method	Date	Length	Width	Water Temp °C	Total Captured ≥70 mm (all fish)[a]	Population Estimate (Range)	Fish/ 100 mm^2	Rb	Bk	Bl	Sculpin Present	Comments
Summit Creek #2 (BLM #2)	1.6 km below Sawmill Road	3 pass	8/92	106	2.8	- -	70	72 (70-76)	24.3	100	- -	- -	- -	
Summit Creek #3 (BLM #1)	0.8 km below Sawmill Road	3 pass	8/92	110	3.0	- -	129	130 (129-133)	39.4	100	- -	- -	- -	
Summit Creek #4[d]	400 m below Sawmill Canyon Rd	1 pass	10/95	75[b]	3.0[b]	- -	65 (65)	- -	- -	95	3	2	yes	
Summit Creek #6	Iron Springs	1 pass	6/97	170	7.3	12	6 (6)	- -	- -	100	- -	- -	yes	
Timber Creek #1	0.8 km above Little Lost River	3 pass 2 pass	7/97 8/95	133 133	4.7 3.6	10 10	42 (46) 23 (23)	43 (42-45) 26 (23-30)	6.9 5.5	5 17	- - - -	95 83	yes yes	
Timber Creek #2	100 m above Slide Creek	hook and line	6/97	100[b]	2.0[b]	- -	1 (1)	- -	- -	- -	- -	100	no	approx. 5 other bull trout between 100-200 mm were observed

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Stream	Location	Sampling Method	Date	Length	Width	Water Temp °C	Total Captured ≥70 mm (all fish)[a]	Population Estimate (Range)	Fish/ 100 mm^2	Rb	Bk	Bl	Sculpin Present	Comments
Warm Creek #1	0.4 km above Little Lost	2 pass	6/95	47	2.6	10	8 (8)	8 (8-9)	6.7	100	- -	- -	no	
Warm Creek #2	0.6 km above upper Forest boundary	1 pass	6/95	34	2	7	1 (1)	- -	- -	- -	- -	100	no	2 bull trout approx. 70 and 110 mm were observed but uncaptured
Warm Springs Creek (BLM)	below Little Lost Highway	2 pass	8/93	115	3.3	- -	86	94 (88-99)	24.8	100	- -	- -	- -	
Wet Creek (BLM #7)	just below Pancheri diversion	3 pass	8/92	118	3.7	- -	27	28 (27-31)	6.4	85	7	7	- -	
Wet Creek (BLM #6)	just below Dry Creek hydro	2 pass	8/92	94	4.4	- -	4	5 (4-6)	1.2	75	- -	25	- -	
Wet Creek (BLM #5)	3.6 km below Squaw Creek	2 pass	8/92	129	4.4	- -	25	29 (25-35)	5.1	96	- -	4	- -	

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Wet Creek (BLM #4)	2.0 km below Squaw Creek	3 pass	8/92	96	3.9	- -	21	22 (21-24)	5.9	100	- -	- -	- -	
Wet Creek (BLM #2)	0.8 km below #1	2 pass	8/92	117	3.3	- -	19	20 (19-21)	5.2	100	- -	- -	- -	
Wet Creek (BLM #1)	2.4 km below Forest boundary	2 pass	8/92	89	4.3	- -	21	22 (21-24)	5.7	100	- -	- -	- -	
Wet Creek #0	top end of transect is Big Creek	1 pass	7/97	170	5.1	10	16 (16)	- -	- -	81	13	6	yes	
Wet Creek #1	0.6 km above Forest boundary	1 pass 3 pass	7/96 7/95	104 192	2.2 2.2	10 15	28 (28) 34 (34)	- - 35 (34-37)	- - 8.3	96 100	- - - -	4 - -	yes yes	
Wet Creek #1a	250 m above Coal Creek	1 pass	7/96	87	2.3	12	15 (15)	- -	- -	73	- -	27	yes	
Wet Creek #1aa	beaver pond below Hilts Creek	snorkel	7/96	- -	- -	10	- -	- -	- -	40[b]	- -	60[b]	- -	

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Wet Creek #1b	at Hilts Creek	2 pass	8/97	102	3.6	12	65 (65)	69 (65-76)	18.8	37	- -	63	yes	
Wet Creek #2	0.5 km above Hilts Creek (top end of private)	2 pass	8/95	151	3.5	- -	12 (13)	13 (12-14)	2.4	75	- -	25	yes	
Wet Creek #3	0.8 km above Hilts Creek (in meadow)	3 pass 2 pass	6/96 8/95	138 95	3.6 2.8	10 8	54 (54) 29 (29)	56 (54-60) 32 (29-36)	11.3 12.1	28 31	- - - -	72 69	no no	
Wet Creek #3a	108 m above #3	2 pass	6/96	48	2.8	9	11 (11)	11 (11-12)	8.2	36	- -	64	no	
Wet Creek #4	2.2 km above Hilts Creek	1 pass	7/95	135	2.0	7	none observed	- -	- -	- -	- -	- -	no	included 3 sections on main channel and 1 on a side channel
Wet Creek, unnamed tributary (across from Coal Creek) #1	100 m above Wet Creek	1 pass	9/95	34	1.0	12	- - (30[b])	- -	- -	- -	- -	- -	no	all fish were rainbow trout 35-65 mm

APPENDIX A: Summary of sampling efforts and results in the Little Lost River drainage between 1992 and 1997. (Calculations are for fish greater than or equal to 70 millimeters, except for Bureau of Land Management sites sampled between 1992 and 1994 which are for fish greater than or equal to 100 millimeters.) (Adapted from LLRITAT 1998, Gamett 1999.)

Stream	Location	Sampling Method	Date	Length	Width	Water Temp °C	Total Captured ≥70 mm (all fish)[a]	Population Estimate (Range)	Fish/ 100 mm^2	Rb	Bk	Bl	Sculpin Present	Comments
Wet Creek, unnamed tributary (across from Coal Creek) #2	0.6 km above Wet Creek	1 pass	7/97	91	1.2	10	20 (21)	- -	- -	100	- -	- -	no	
Williams Creek #1	1.6 km below Forest boundary	1 pass	6/95	75[b]	1.0[b]	- -	1 (1)	- -	- -	- -	- -	100	yes	
Williams Creek #2	beaver pond at Forest boundary	hook and line	6/97	- -	- -	- -	7 (7)	- -	- -	- -	- -	100	- -	
Williams Creek #3	1.6 km above Forest boundary	3 pass	6/95	49	1.4	8	7 (12)	7 (7-8)	10.4	- -	- -	100	no	

[a] For BLM sites sampled between 1992 and 1994 this column indicates number of fish ≥100 mm.

[b] Represents an estimate or an approximation.

[c] More fish were captured in this transect than could be held between passes. Therefore, fish were released below the transect between passes. It may be possible that some of these fish moved back into the transect, were recaptured, and recounted.

APPENDIX B: Approach used by the Little Lost River Recovery Unit Team to develop potential recovery tasks.

Instructions

Step 1. The purpose of this step is to list, define, and describe each bull trout population. On Table 1, complete the following:

A. Population: List the name of each population

B. Population Description:

1. Define the drainage occupied by the population

2. List the streams or stream reaches currently occupied

3. Provide an estimate of the amount of occupied habitat

4. Provide an estimate of the current adult population (fish greater than180 millimeters)

5. Discuss significant habitat that is unoccupied

6. Describe significant artificial and natural barriers

Step2 . The purpose of this step is to determine which populations are currently meeting recovery objectives and which populations are not. On Table 2, complete the following:

A. Population: From Table 1, list the name of each population

B. Evaluation of Recovery Objectives

1. Distribution/Abundance: Categorize the current distribution and abundance of the bull trout population relative to historic levels. If available, this determination should be based on data. If sufficient data are unavailable, this determination may be based on professional judgment.

a. Yes – Abundance and/or distribution is at or near historic levels

b. No – Relative to historic levels, abundance and/or distribution of the population has experienced major declines or the population is extinct

c. Unknown

2. Trend: Categorize the current population trend. If available, this determination should be based on data. If sufficient data are unavailable, this determination may be based on professional judgment.

a. Yes – Abundance and distribution is increasing or stable over all or most of the drainage

b. No – Abundance and/or distribution is decreasing over all or most of the drainage

c. Unknown

3. Habitat Conditions: Categorize the habitat conditions as to whether they are suitable to maintain all life- history stages and strategies

a. Yes– Relative to historic levels, suitable habitat exists to maintain all life-history stages and strategies over all or most of the drainage

b. No – Relative to historic levels, suitable habitat does not exist to maintain all life-history stages and strategies over all or most of the drainage

c. Unknown

4. Genetic Exchange: Categorize whether artificial barriers have interfered with the ability of fish to move out of or into the population.

a. Yes – Artificial barriers do not restrict the ability of fish to move into or out of historically occupied habitat over all or most of the drainage

b. No – Artificial barriers do restrict the ability of fish to move into or out of historically occupied habitat over all or most of the drainage

c. Unknown

5. Does the population meet recovery objectives?: In order to qualify for a "Yes" all four recovery objectives must have been answered with a "Yes". Otherwise, enter a "No".

Step 3. The purpose of this step is to identify potential actions to ensure populations that are currently meeting recovery objectives continue to meet recovery objectives. On Table 3, complete the following:

A. Population: From Table 2, list those populations that are currently meeting the recovery objectives.

B. Potential Actions to Ensure that the Populations Continues to Meet Recovery Objectives: List potential actions, if any, that might be implemented to ensure the population continues to meet recovery objectives?

Step 4. The purpose of this step is to determine why populations that are not meeting recovery objectives are not meeting recovery objectives. On Table 4, complete the following:

A. Population: From Table 2, list the name of each population that is not meeting recovery objectives.

B. Life History Stage, Factor, Evaluation: Using natural conditions as the baseline, evaluate the effect of each factor on the population with '0" being no affect and "3" being a severe effect. For example, if the team were evaluating the factor "Has access between fluvial adult rearing and spawning areas been physically blocked or restricted?" and a diversion structure 5 feet high with no bypass facilities had been placed in the migratory corridor, they would likely rate this factor as a "3". However, if a completely functional bypass structure was in place they would likely rate this as a "0." Remember to focus the evaluation only on the particular life history stage. For example, if an irrigation diversion was in operation during July and August and reduced flows resulted in increased temperatures only during that time, then it would be inappropriate to identify modified temperatures as affecting incubation, hatching, and emergence. "Unknown" may be entered where information is insufficient to make a determination.

C. Discussion: Briefly discuss rationale for the decision.

Step 5. The purpose of this step is to develop potential recovery actions for those populations that are currently not meeting recovery objectives that will result in the population meeting the recovery objectives. On Table 5, complete the following:

A. Population: From Table 4, list the name of each population that is not meeting the recovery objectives.

B. Critical Factors Adversely Affecting the Population: From Table 4, list factors that are preventing the population from meeting recovery objectives. This will generally be factors rated as "2" or "3." For example, if the team rated the factor "Has access between fluvial adult rearing and spawning areas been physically blocked or restricted?" as a "3," they would likely list this as a critical factor on this table.

C. Cause of the Factors Adversely Affecting the Population: Determine the cause of the factor adversely affecting the population. For example, if the team had listed "access between fluvial adult rearing and spawning areas has been physically blocked", they would list the reason, or reasons, why the access was blocked.

D. Potential Actions to Remove or Reduce the Adverse Affect: Determine potential specific, on the ground actions that would remove or reduce the adverse affect.

Step 6. The purpose of this step is to identify any additional potential actions to protect existing bull trout populations that are currently not meeting recovery objectives. On Table 6, complete the following:

A. Population: From Table 4, list the name of each population that is not meeting the recovery objectives.

B. Potential Actions to Protect Populations: List potential actions, if any, which might be implemented to protect the population.

Step 7. The purpose of this step is to determine the appropriate protection and recovery actions. These actions will ensure that those populations that are currently meeting recovery objectives continue to meet recovery objectives and those populations that are not meeting recovery objectives will meet recovery objectives. On Table 7, complete the following:

A. Population: From Table 1, list all populations.

B. Potential Actions to Protect of Recover the Population: Using the last column of Table 3, the last column of Table 5, and the last column of Table 6, list potential actions to protect and/or recover the population.

C. Is the action biologically, economically, and socially feasible?: Determine if the proposed recovery action is biologically, economically, and socially feasible to implement. In order to answer "Yes", the action should meet all three criteria.

D. Discussion: If action is not biologically, economically, and/or socially feasible, briefly discuss why.

E. Recommended Action: If the potential action is determined to be biologically, economically, and socially feasible, enter a "Yes".

Step 8. The purpose of this step is to develop the protection and recovery plan. On Table 8, complete the following:

A. Population: From Table 1, list all populations.

B. Recommended Action: From Table 7, list all recommended actions to protect or recover each population. If no actions are recommended for a population enter "None".

C. Responsible Organization(s): Determine the organization(s) that will be responsible for carrying out the recommended action.

D. Target Date: Determine the target date for implementing the recommended action.

Table 1. Bull trout populations.

Population	Population Description
Badger Creek	This population occupies the Badger Creek drainage. Currently occupied habitat includes Badger Creek from the Little Lost River upstream to the source springs and Bunting Canyon Creek from Badger Creek upstream approximately 300 m to a small barrier. The total amount of habitat that is currently occupied is estimated at 12 km and the current adult population (≥ 180 mm) is approximately 300 fish. The majority of fish are found in Bunting Canyon Creek and Badger Creek between the National Forest boundary and Bunting Canyon Creek. It is unclear if bull trout were ever present in Bunting Canyon Creek above the barrier although the habitat does appear suitable for bull trout. The lower 0.5 km of Badger Creek is intermittently dewatered during the summer months. Seasonal dewatering of this section of stream likely interferes with fish migration out of Badger Creek and the diversion structure appears to block upstream migration into Badger Creek. There are no other artificial barriers known in this drainage.
Williams Creek	This population occupies the Williams Creek drainage. Currently occupied habitat includes Williams Creek from an irrigation diversion located approximately 2 km above the Little Lost River upstream to the source springs. The total amount of habitat that is currently occupied is estimated at 4 km and the current adult population (≥ 180 mm) is approximately 100 fish. The majority of fish are found in the reach of stream above the National Forest boundary. Williams Creek has been isolated from the Little Lost River by two water diversions. The lower diversion, which is located approximately 2 km above the Little Lost River, completely dewaters Williams Creek during the spring, summer, and fall. The upper diversion, which is located approximately 1 km above the lower diversion, completely dewaters Williams Creek during the winter. These diversions prevent fish from migration into or out of Williams Creek. There are no other artificial barriers known in this drainage.
Wet Creek	This population occupies the Wet Creek drainage. Currently occupied habitat includes Wet Creek from the Little Lost River upstream to a barrier falls located approximately 2 km above Hilts Creek. This population is believed to be divided into two distinct groups of fish by a barrier created by an old diversion and a cascade located above Hilts Creek. The upper group occupies approximately 700 m of stream between the old diversion and the barrier falls. The lower group extends from the old diversion structure downstream to the Little Lost River. The total amount of habitat that is currently occupied is estimated at 28 km. Prior to 2000, the adult population (≥ 180 mm) was approximately 600 fish. However, sampling completed in 2001 suggests that major declines in the population have occurred and the current adult population may be less than 100 fish. The reason for this decline is not known. However, it may be associated with extreme winter conditions resulting from several years of drought. The majority of fish are found in that reach of stream between Coal Creek and the barrier falls. Bull trout historically occupied Big Creek. However, sampling completed in 1999 suggests the population has been extirpated. This population likely consisted of 500 to 1000 adult fish. It is unknown if bull trout ever occupied Basin Creek, Squaw Creek, or Coal Creek. An irrigation diversion located on lower Wet

Table 1. Bull trout populations.

Population	Population Description
	Creek that was thought to be a complete barrier to upstream movement of fish was bypassed with a fish ladder that was constructed in 1992. With the exception of this diversion and the old diversion mentioned above, there are no other artificial barriers known in this drainage.
Warm Creek	This population occupies the Warm Creek drainage. Currently occupied habitat includes Warm Creek from the Little Lost River upstream to the source springs. The total amount of habitat that is currently occupied is estimated at 3 km and the current adult population (≥ 180 mm) is approximately 50 fish. The majority of fish are found in the upper 2 km of stream. There are no artificial barriers known in this drainage.
Squaw Creek	This population occupies the Squaw Creek drainage. Currently occupied habitat includes Squaw Creek from the Little Lost River upstream to the source springs, North Fork Squaw Creek from Squaw Creek upstream to the source springs, and an unnamed tributary to Squaw Creek from Squaw Creek to the source springs. The total amount of habitat that is currently occupied is estimated at 9 km and the current adult population (≥ 180 mm) is approximately 200 fish. The majority of fish are found in North Fork Squaw Creek and Squaw Creek above the unnamed tributary. A temporary, experimental fish barrier was installed on Squaw Creek immediately above North Fork Squaw Creek in 2001. The purpose of this barrier was to prevent brook trout from reinvading the upper portion of Squaw Creek following removal of brook trout. There are no other artificial barriers known in this drainage.
Mill Creek	This population occupies the Mill Creek drainage. Currently occupied habitat includes Mill Creek from the Little Lost River upstream to a barrier falls. The total amount of habitat that is currently occupied is estimated at 4 km and the current adult population (≥ 180 mm) is approximately 100 fish. The majority of fish are found in that reach of stream upstream from the Mill Creek Trailhead. There are no artificial barriers known in this drainage.
Iron Creek	This population occupies the Iron Creek drainage. Currently occupied habitat includes Iron Creek from the Little Lost River upstream to Left Fork Iron Creek, Left Fork Iron Creek from Iron Creek upstream approximately 1 km, Right Fork Iron Creek from Iron Creek upstream approximately 500 m, Jackson Creek from Iron Creek to the source springs, and Hawley Creek from Iron Creek to the source springs. The total amount of habitat that is currently occupied is estimated at 11 km and the current adult population (≥ 180 mm) is approximately 100 fish. Good densities of bull trout are present throughout the drainage. Culverts associated with Forest Service Road #104 on Jackson Creek and Hawley Creek may interfere with upstream movement of fish. There are no other artificial barriers known in this drainage.

Table 1. Bull trout populations.

Population	Population Description
Timber Creek	This population occupies the Timber Creek drainage. Currently occupied habitat includes Timber Creek from the Little Lost River to the source springs, Camp Creek from Timber Creek upstream approximately 1 km, Redrock Creek from Timber Creek upstream approximately 1 km, and Slide Creek from Timber Creek upstream approximately 0.5 km. The total amount of habitat that is currently occupied is estimated at 10 km and the current adult population (≥ 180 mm) is approximately 200 fish. Good densities of bull trout are present throughout the drainage. A head-cut associated with a road crossing on Camp Creek appears to be a barrier to upstream fish movement. Likewise, a culvert associated with Forest Service Road #105 on Timber Creek and a culvert associated with Forest Service Road #460 on Redrock Creek may interfere with the upstream movement of small fish. There are no other artificial barriers known in this drainage.
Smithie Fork Creek	This population occupies the Smithie Fork drainage. Currently occupied habitat includes Smithie Fork Creek from the Little Lost River upstream to the source springs. The total amount of habitat that is currently occupied is estimated at 7 km and the current adult population (≥ 180 mm) is approximately 1,300 fish. Bull trout densities in this population are very high with densities of fish (≥ 70 mm) exceeding 15.0 fish/100 m^2 throughout much of the drainage. There are no artificial barriers known in this drainage.
Upper Little Lost River	This population occupies the Little Lost River drainage upstream of Iron Creek, excluding the Timber Creek and Smithie Fork drainages. Currently occupied habitat includes the Little Lost River from Iron Creek upstream to the source springs, Right Fork Little Lost River from the Little Lost River upstream approximately 1 km, and Firebox Creek from the Little Lost River upstream approximately 2 km. The total amount of habitat that is currently occupied is estimated at 13 km and the current adult population (≥ 180 mm) is approximately 3,800 fish. Bull trout densities in this population are very high with densities of fish (≥ 70 mm) exceeding 15.0 fish/100 m^2 throughout much of the drainage. It is unclear if bull trout were ever present in Moonshine Creek although the habitat does appear suitable for bull trout. A culvert on Moonshine Creek may be a barrier to the upstream movement of fish. Likewise, two culverts associated with Forest Service Road #101 on the Little Lost River may interfere with the upstream movement of small fish. . There are no other artificial barriers known in this drainage.
Middle Little Lost River	This area includes the mainstem of the Little Lost River from Summit Creek to Iron Creek. This reach of stream is not designated as a population. However, this stream reach does serve as an important migratory corridor and rearing area for adult fluvial bull trout associated with upstream populations. Currently occupied habitat includes the Little Lost River from Summit Creek upstream to the Iron Creek. The total amount of habitat that is currently occupied is estimated at 23 km and the current adult population (≥ 180 mm)

Table 1. Bull trout populations.

Population	Population Description
	is approximately 300 fish. There are no artificial barriers known in this stream reach.
Lower Little Lost River	This area includes the mainstem of the Little Lost River from the Little Lost River Sinks to Summit Creek. This reach of stream is not designated as a population. However, this stream reach does serve as an important migratory corridor and rearing area for adult fluvial bull trout associated with upstream populations. Currently occupied habitat includes the Little Lost River from the flood control diversion structure upstream to Summit Creek. The total amount of habitat that is currently occupied is estimated at 55 km and the current adult population (≥ 180 mm) is approximately 500. Adult fluvial bull trout historically occupied the entire reach of stream from the Little Lost River Sinks upstream to Summit Creek. The lower portion of the river is dewatered annually during the winter for flood control. There are several other diversions present in this reach although it is unknown whether these diversions interfere with fish movement.

Table 2. Evaluation of bull trout populations.

Population	Evaluation of Recovery Objectives				Does the population meet recovery objectives?
	Distribution/Abundance	**Trend**	**Habitat Conditions**	**Genetic Exchange**	
Badger Creek	No	Yes	No	No	No
Williams Creek	Yes	Yes	No	No	No
Wet Creek	No	No	No	Yes	No
Warm Creek	Yes	Yes	Yes	Yes	Yes
Squaw Creek	No	No	Yes	Yes	No
Mill Creek	No	No	Yes	Yes	No
Iron Creek	Yes	Yes	Yes	Yes	Yes
Timber Creek	Yes	Yes	Yes	Yes	Yes
Smithie Fork Creek	Yes	Yes	Yes	Yes	Yes
Upper Little Lost River	Yes	Yes	Yes	Yes	Yes
Middle Little Lost River	No	Yes	No	Yes	No
Lower Little Lost River	No	Yes	No	?	No

Table 3. Potential actions to ensure populations that are currently meeting recovery objectives continue to meet recovery objectives.

Population	Potential Actions to Ensure that the Population Continues to Meet Recovery Objectives
Warm Creek	1. Monitor lower portion of stream to detect invasion by brook trout. If brook trout are found to be invading the stream work to prevent the invasion. 2. Evaluate effect of livestock grazing on spawning and egg incubation and adjust grazing strategy as appropriate
Iron Creek	1. Continue to implement grazing plan developed as part of consultation making revisions as necessary. 2. Monitor lower portion of stream to detect invasion by brook trout. If brook trout are found to be invading the stream work to prevent the invasion. 3. Evaluate fish passage through culverts associated with Forest Service Road #104 on Jackson Creek and Hawley Creek and modify/replace as necessary to provide for fish passage. 4. Reduce sediment from roads and trails. 5. Evaluate effect of livestock grazing on spawning and egg incubation and adjust grazing strategy as appropriate
Timber Creek	1. Continue to implement grazing plan developed as part of consultation making revisions as necessary. 2. Monitor lower portion of stream to detect invasion by brook trout. If brook trout are found to be invading the stream work to prevent the invasion. 3. Remove artificial barrier on lower Camp Creek 4. Reduce sediment from roads and trails. 5. Evaluate fish passage through a culvert associated with Forest Service Road #105 on Timber Creek and a culvert associated with Forest Service Road #460 on Redrock Creek and modify/replace as necessary to provide for fish passage. 6. Evaluate effect of fishing (e.g. - illegal harvest, hooking mortality, etc.) on the population and implement any appropriate actions (e.g. - angler education, enforcement, revision of regulations). 7. Evaluate effect of livestock grazing on spawning and egg incubation and adjust grazing strategy as appropriate
Smithie Fork Creek	1. Continue to implement grazing plan developed as part of consultation making revisions as necessary. 2. Monitor lower portion of stream to detect invasion by brook trout. If brook trout are found to be invading the stream work to prevent the invasion. 3. Evaluate effect of fishing (e.g. - illegal harvest, hooking mortality, etc.) on the population and implement any appropriate actions (e.g. - angler education, enforcement, revision of regulations). 4. Evaluate effect of livestock grazing on spawning and egg incubation and adjust grazing strategy as appropriate
Upper	1. Continue to implement grazing plan developed as part of consultation making revisions as necessary.

Table 3. Potential actions to ensure populations that are currently meeting recovery objectives continue to meet recovery objectives.

Population	Potential Actions to Ensure that the Population Continues to Meet Recovery Objectives
Little Lost River	2. Monitor lower portion of stream to detect invasion by brook trout. If brook trout are found to be invading the stream work to prevent the invasion. 3. Evaluate potential of Moonshine Creek to support bull trout. If it is suitable, replace culvert to provide for fish passage and introduce bull trout into Moonshine Creek. 4. Evaluate fish passage through two culverts associated with Forest Service Road #101 on the Little Lost River and modify/replace as necessary to provide for fish passage. 5. Evaluate effect of fishing (e.g. - illegal harvest, hooking mortality, etc.) on the population and implement any appropriate actions (e.g. - angler education, enforcement, revision of regulations). 6. Evaluate effect of livestock grazing on spawning and egg incubation and adjust grazing strategy as appropriate

Table 4. Evaluation of populations that are not meeting recovery goals and objectives.

Population	Life History Stage	Factor	Evaluation	Discussion
Badger Creek	Incubation, Hatching, and Emergence *(September 1 – May 1)*	Has the temperature regime been modified?	0	
		Have oxygen levels decreased?	0	
		Have flow regimes been modified?	0	
		Has egg and/or alevin mortality resulting from physical disturbance increased?	?	Timing of grazing on private land is unknown.
		Have sediment levels increased?	2	High levels of sediment resulting from habitat alteration in upper reaches of stream.
	Juvenile/Adult Summer Rearing *(May 1 – September 30)*	Has the temperature regime increased?	1	A minor increase in temperature has likely occurred as a result of habitat disturbance.
		Has food production decreased?	0	
		Has habitat quantity decreased?	1	Lower section of stream is intermittently dewatered during the summer and fall.
		Has habitat quality decreased?	1	Some habitat disturbance resulting from roads and grazing.
		Has water quality decreased?	0	
		Has mortality increased?	1	Losses relating to stream dewatering and diversion are likely.
	Juvenile/Adult Winter Rearing *(October 1 – April 30)*	Has the temperature regime been modified?		
		Has food production	0	

Table 4. Evaluation of populations that are not meeting recovery goals and objectives.

Population	Life History Stage	Factor	Evaluation	Discussion
		decreased?		
		Has habitat quantity decreased?	0	
		Has habitat quality decreased?	1	Some habitat disturbance resulting from roads and grazing.
		Has water quality decreased?	0	
		Has mortality increased?	0	
	Migration/Genetic Consideration *(Year Round)*	Has the ability for movement within the population been modified?	0	
		Has the potential for emigration or immigration been decreased?	3	Immigration is likely totally restricted by irrigation diversion and emigration is affected by dewatering of stream channel.
	Spawning *(September 1 – November 30)*	Have temperature regime been modified?	0	
		Has mortality increased?	0	
		Has quantity of spawning habitat decreased?	0	
	Exotic Species Considerations	Is there competition with exotic species?	0	
		Is there predation from exotic species?	0	
		Is there hybridization with exotic species?	0	
	Fluvial Juvenile Migration *(May 1 – November 30)*	Has access between juvenile rearing and fluvial adult rearing areas been physically blocked or restricted?	2	

Table 4. Evaluation of populations that are not meeting recovery goals and objectives.

Population	Life History Stage	Factor	Evaluation	Discussion
		Have temperature regimes between juvenile rearing and fluvial adult rearing areas been modified?	0	
		Has mortality increased?	1	
	Fluvial Adult Migration *(May 1 – November 30)*	Has access between fluvial adult rearing and spawning areas been physically blocked or restricted?	2	
		Have temperature regime between fluvial adult rearing and spawning areas been modified?	1	
		Has mortality increased?	0	
Williams Creek	Incubation, Hatching, and Emergence *(September 1 – May 1)*	Has the temperature regime been modified?	0	
		Have oxygen levels decreased?	0	
		Have flow regimes been modified?	0	
		Has egg and/or alevin mortality resulting from physical disturbance increased?	0	
		Have sediment levels increased?	1	
	Juvenile/Adult Summer Rearing *(May 1 – September 30)*	Has the temperature regime increased?	1	

Table 4. Evaluation of populations that are not meeting recovery goals and objectives.

Population	Life History Stage	Factor	Evaluation	Discussion
		Has food production decreased?	0	
		Has habitat quantity decreased?	2	Habitat loss resulting from lower section of stream being permanently dewatered.
		Has habitat quality decreased?	2	Habitat in lower section in poor condition
		Has water quality decreased?	0	
		Has mortality increased?	1	
	Juvenile/Adult Winter Rearing *(October 1 – April 30)*	Has the temperature regime been modified?	0	
		Has food production decreased?	0	
		Has habitat quantity decreased?	2	Habitat loss resulting from lower section of stream being permanently dewatered.
		Has habitat quality decreased?	2	Habitat in lower section in poor condition
		Has water quality decreased?	0	
		Has mortality increased?	1	
	Migration/Genetic Consideration *(Year Round)*	Has the ability for movement within the population been modified?	0	
		Has the potential for emigration or immigration been decreased?	3	
	Spawning *(September 1 – November 30)*	Have temperature regime been modified?	0	
		Has mortality increased?	0	

Table 4. Evaluation of populations that are not meeting recovery goals and objectives.

Population	Life History Stage	Factor	Evaluation	Discussion
		Has quantity of spawning habitat decreased?	0	
	Exotic Species Considerations	Is there competition with exotic species?	0	
		Is there predation from exotic species?	0	
		Is there hybridization with exotic species?	0	
	Fluvial Juvenile Migration *(May 1 – November 30)*	Has access between juvenile rearing and fluvial adult rearing areas been physically blocked or restricted?	3	
		Have temperature regimes between juvenile rearing and fluvial adult rearing areas been modified?	1	
		Has mortality increased?	1	
	Fluvial Adult Migration *(May 1 – November 30)*	Has access between fluvial adult rearing and spawning areas been physically blocked or restricted?	3	
		Have temperature regime between fluvial adult rearing and spawning areas been modified?	1	
		Has mortality increased?	0	
Wet Creek	Incubation, Hatching, and Emergence *(September 1 – May 1)*	Has the temperature regime been modified?	0	

Table 4. Evaluation of populations that are not meeting recovery goals and objectives.

Population	Life History Stage	Factor	Evaluation	Discussion
		Have oxygen levels decreased?	0	
		Have flow regimes been modified?	0	
		Has egg and/or alevin mortality resulting from physical disturbance increased?	0	
		Have sediment levels increased?	2	
	Juvenile/Adult Summer Rearing *(May 1 – September 30)*	Has the temperature regime increased?	2	
		Has food production decreased?	0	
		Has habitat quantity decreased?	0	
		Has habitat quality decreased?	2	
		Has water quality decreased?	0	
		Has mortality increased?	1	
	Juvenile/Adult Winter Rearing *(October 1 – April 30)*	Has the temperature regime been modified?	0	
		Has food production decreased?	0	
		Has habitat quantity decreased?	0	

Table 4. Evaluation of populations that are not meeting recovery goals and objectives.

Population	Life History Stage	Factor	Evaluation	Discussion
		Has habitat quality decreased?	2	
		Has water quality decreased?	0	
		Has mortality increased?	0	
	Migration/Genetic Consideration *(Year Round)*	Has the ability for movement within the population been modified?	0	
		Has the potential for emigration or immigration been decreased?	0	
	Spawning *(September 1 – November 30)*	Have temperature regime been modified?	1	
		Has mortality increased?	1	
		Has quantity of spawning habitat decreased?	0	
	Exotic Species Considerations	Is there competition with exotic species?	2	
		Is there predation from exotic species?	1	
		Is there hybridization with exotic species?	2	
	Fluvial Juvenile Migration *(May 1 – November 30)*	Has access between juvenile rearing and fluvial adult rearing areas been physically blocked or restricted?	0	
		Have temperature regimes between juvenile rearing and fluvial adult rearing areas	1	

Table 4. Evaluation of populations that are not meeting recovery goals and objectives.

Population	Life History Stage	Factor	Evaluation	Discussion
		been modified?		
		Has mortality increased?	0	
	Fluvial Adult Migration *(May 1 – November 30)*	Has access between fluvial adult rearing and spawning areas been physically blocked or restricted?	0	
		Have temperature regime between fluvial adult rearing and spawning areas been modified?	2	
		Has mortality increased?	1	
Squaw Creek	Incubation, Hatching, and Emergence *(September 1 – May 1)*	Has the temperature regime been modified?	0	
		Have oxygen levels decreased?	0	
		Have flow regimes been modified?	0	
		Has egg and/or alevin mortality resulting from physical disturbance increased?	0	
		Have sediment levels increased?	1	
	Juvenile/Adult Summer Rearing *(May 1 – September 30)*	Has the temperature regime increased?	1	
		Has food production decreased?	0	
		Has habitat quantity	0	

Table 4. Evaluation of populations that are not meeting recovery goals and objectives.

Population	Life History Stage	Factor	Evaluation	Discussion
		decreased?		
		Has habitat quality decreased?	1	
		Has water quality decreased?	0	
		Has mortality increased?	1	
	Juvenile/Adult Winter Rearing *(October 1 – April 30)*	Has the temperature regime been modified?	0	
		Has food production decreased?	0	
		Has habitat quantity decreased?	0	
		Has habitat quality decreased?	1	
		Has water quality decreased?	0	
		Has mortality increased?	0	
	Migration/Genetic Consideration *(Year Round)*	Has the ability for movement within the population been modified?	0	
		Has the potential for emigration or immigration been decreased?	0	
	Spawning *(September 1 – November 30)*	Have temperature regime been modified?	0	
		Has mortality increased?	1	
		Has quantity of spawning habitat decreased?	0	
	Exotic Species Considerations	Is there competition with exotic species?	3	

Table 4. Evaluation of populations that are not meeting recovery goals and objectives.

Population	Life History Stage	Factor	Evaluation	Discussion
		Is there predation from exotic species?	3	
		Is there hybridization with exotic species?	3	
	Fluvial Juvenile Migration *(May 1 – November 30)*	Has access between juvenile rearing and fluvial adult rearing areas been physically blocked or restricted?	0	
		Have temperature regimes between juvenile rearing and fluvial adult rearing areas been modified?	1	
		Has mortality increased?	0	
	Fluvial Adult Migration *(May 1 – November 30)*	Has access between fluvial adult rearing and spawning areas been physically blocked or restricted?	0	
		Have temperature regime between fluvial adult rearing and spawning areas been modified?	1	
		Has mortality increased?	1	
Mill Creek	Incubation, Hatching, and Emergence *(September 1 – May 1)*	Has the temperature regime been modified?	0	
		Have oxygen levels decreased?	0	
		Have flow regimes been modified?	0	

Table 4. Evaluation of populations that are not meeting recovery goals and objectives.

Population	Life History Stage	Factor	Evaluation	Discussion
		Has egg and/or alevin mortality resulting from physical disturbance increased?	0	
		Have sediment levels increased?	1	
	Juvenile/Adult Summer Rearing *(May 1 – September 30)*	Has the temperature regime increased?	1	
		Has food production decreased?	0	
		Has habitat quantity decreased?	0	
		Has habitat quality decreased?	1	
		Has water quality decreased?	0	
		Has mortality increased?	1	
	Juvenile/Adult Winter Rearing *(October 1 – April 30)*	Has the temperature regime been modified?	0	
		Has food production decreased?	0	
		Has habitat quantity decreased?	0	
		Has habitat quality decreased?	1	
		Has water quality decreased?	0	
		Has mortality increased?	0	

Table 4. Evaluation of populations that are not meeting recovery goals and objectives.

Population	Life History Stage	Factor	Evaluation	Discussion
	Migration/Genetic Consideration *(Year Round)*	Has the ability for movement within the population been modified?	0	
		Has the potential for emigration or immigration been decreased?	0	
	Spawning *(September 1 – November 30)*	Have temperature regime been modified?	0	
		Has mortality increased?	1	
		Has quantity of spawning habitat decreased?	0	
	Exotic Species Considerations	Is there competition with exotic species?	3	
		Is there predation from exotic species?	3	
		Is there hybridization with exotic species?	3	
	Fluvial Juvenile Migration *(May 1 – November 30)*	Has access between juvenile rearing and fluvial adult rearing areas been physically blocked or restricted?	0	
		Have temperature regimes between juvenile rearing and fluvial adult rearing areas been modified?	1	
		Has mortality increased?	0	
	Fluvial Adult Migration *(May 1 – November 30)*	Has access between fluvial adult rearing and spawning areas been physically	0	

Table 4. Evaluation of populations that are not meeting recovery goals and objectives.

Population	Life History Stage	Factor	Evaluation	Discussion
		blocked or restricted?		
		Have temperature regime between fluvial adult rearing and spawning areas been modified?	1	
		Has mortality increased?	N/A	
Middle Little Lost River	Incubation, Hatching, and Emergence *(September 1 – May 1)*	Has the temperature regime been modified?	N/A	
		Have oxygen levels decreased?	N/A	
		Have flow regimes been modified?	N/A	
		Has egg and/or alevin mortality resulting from physical disturbance increased?	N/A	
		Have sediment levels increased?	N/A	
	Juvenile/Adult Summer Rearing *(May 1 – September 30)*	Has the temperature regime increased?	2	
		Has food production decreased?	1	
		Has habitat quantity decreased?	2	
		Has habitat quality decreased?	2	
		Has water quality decreased?	0	

Table 4. Evaluation of populations that are not meeting recovery goals and objectives.

Population	Life History Stage	Factor	Evaluation	Discussion
		Has mortality increased?	1	
	Juvenile/Adult Winter Rearing *(October 1 – April 30)*	Has the temperature regime been modified?	1	
		Has food production decreased?	1	
		Has habitat quantity decreased?	2	
		Has habitat quality decreased?	2	
		Has water quality decreased?	0	
		Has mortality increased?	0	
	Migration/Genetic Consideration *(Year Round)*	Has the ability for movement within the population been modified?	1	Temperature regimes and habitat alterations may limit movement
		Has the potential for emigration or immigration been decreased?	0	
	Spawning *(September 1 – November 30)*	Have temperature regime been modified?	N/A	
		Has mortality increased?	N/A	
		Has quantity of spawning habitat decreased?	N/A	
	Exotic Species Considerations	Is there competition with exotic species?	1	
		Is there predation from exotic species?	1	
		Is there hybridization with	N/A	

Table 4. Evaluation of populations that are not meeting recovery goals and objectives.

Population	Life History Stage	Factor	Evaluation	Discussion
		exotic species?		
	Fluvial Juvenile Migration *(May 1 – November 30)*	Has access between juvenile rearing and fluvial adult rearing areas been physically blocked or restricted?	0	
		Have temperature regimes between juvenile rearing and fluvial adult rearing areas been modified?	2	Temperature regimes and habitat alterations may limit movement
		Has mortality increased?	1	
	Fluvial Adult Migration *(May 1 – November 30)*	Has access between fluvial adult rearing and spawning areas been physically blocked or restricted?	0	
		Have temperature regime between fluvial adult rearing and spawning areas been modified?	2	Temperature regimes and habitat alterations may limit movement
		Has mortality increased?	1	
Lower Little Lost River	Incubation, Hatching, and Emergence *(September 1 – May 1)*	Has the temperature regime been modified?	N/A	
		Have oxygen levels decreased?	N/A	
		Have flow regimes been modified?	N/A	
		Has egg and/or alevin mortality resulting from physical disturbance	N/A	

Table 4. Evaluation of populations that are not meeting recovery goals and objectives.

Population	Life History Stage	Factor	Evaluation	Discussion
		increased?		
		Have sediment levels increased?	N/A	
	Juvenile/Adult Summer Rearing *(May 1 – September 30)*	Has the temperature regime increased?	2	
		Has food production decreased?	2	
		Has habitat quantity decreased?	2	
		Has habitat quality decreased?	2	
		Has water quality decreased?	0	
		Has mortality increased?	2	
	Juvenile/Adult Winter Rearing *(October 1 – April 30)*	Has the temperature regime been modified?	1	
		Has food production decreased?	2	
		Has habitat quantity decreased?	2	
		Has habitat quality decreased?	2	
		Has water quality decreased?	0	
		Has mortality increased?	2	
	Migration/Genetic Consideration *(Year Round)*	Has the ability for movement within the population been modified?	Unknown	Some diversions may be preventing movement
		Has the potential for	Unknown	Some diversions may be preventing movement

Table 4. Evaluation of populations that are not meeting recovery goals and objectives.

Population	Life History Stage	Factor	Evaluation	Discussion
		emigration or immigration been decreased?		
	Spawning *(September 1 – November 30)*	Have temperature regime been modified?	N/A	
		Has mortality increased?	N/A	
		Has quantity of spawning habitat decreased?	N/A	
	Exotic Species Considerations	Is there competition with exotic species?	1	
		Is there predation from exotic species?	1	
		Is there hybridization with exotic species?	N/A	
	Fluvial Juvenile Migration *(May 1 – November 30)*	Has access between juvenile rearing and fluvial adult rearing areas been physically blocked or restricted?	Unknown	Some diversions may be preventing movement
		Have temperature regimes between juvenile rearing and fluvial adult rearing areas been modified?	2	Temperature regimes and habitat alterations may limit movement
		Has mortality increased?	Unknown	Juveniles migrating downstream may become entrained in diversions
	Fluvial Adult Migration *(May 1 – November 30)*	Has access between fluvial adult rearing and spawning areas been physically blocked or restricted?	Unknown	Some diversions may be preventing movement
		Have temperature regime between fluvial adult rearing and spawning areas been	2	Temperature regimes and habitat alterations may limit movement

Table 4. Evaluation of populations that are not meeting recovery goals and objectives.

Population	Life History Stage	Factor	Evaluation	Discussion
		modified?		
		Has mortality increased?	1	

Table 5. Assessment of factors adversely affecting the population and potential recovery actions.

Population	Critical Factors Adversely Affecting the Population	Cause of Factor Adversely Affecting the Population	Potential Actions to Remove or Reduce the Adverse Affect
Badger Creek	Increased sediment in spawning areas	Habitat alteration resulting from grazing and roads	Develop management strategy to reduce sediment levels on National Forest and private lands
	Potential for emigration and immigration has decreased	Dewatering stream and irrigation diversion limits upstream and downstream movement of fish	1. Provide for upstream fish passage at diversion 2. Assess feasibility of providing minimum flow between diversion and Little Lost River
	Access between juvenile rearing and fluvial adult rearing areas has been physically restricted	See above	See above
	Access between fluvial adult rearing and spawning areas has been physically restricted	See above	See above
Williams Creek	Juvenile/adult summer and winter habitat quantity has decreased	Dewatering lower section of stream has resulted in a loss of approximately 3 km of habitat	1. Evaluate feasibility of reconnecting Williams Creek to Little Lost River 2. Evaluate feasibility of providing minimum flow between diversions and Little Lost River
	Potential for emigration and immigration has decreased	See above	See above
	Access between juvenile rearing and fluvial adult rearing areas has been physically restricted	See above	See above
	Access between fluvial adult rearing and spawning areas has been physically	See above	See above

Table 5. Assessment of factors adversely affecting the population and potential recovery actions.

Population	Critical Factors Adversely Affecting the Population	Cause of Factor Adversely Affecting the Population	Potential Actions to Remove or Reduce the Adverse Affect
	restricted		
	Juvenile/adult summer and winter habitat quality has decreased	Habitat not fully recovered from past grazing practices	Continue to implement grazing plan developed as part of consultation making revisions as necessary.
Wet Creek	Increased sediment in spawning areas	Habitat alteration resulting from grazing, roads, and trails	Develop and implement management strategy to reduce sediment levels in spawning areas
	Temperature regime in juvenile/adult summer rearing areas has increased	Habitat alteration resulting from grazing	Continue to implement grazing plan developed as part of consultation making revisions as necessary. On Forest lands, place additional emphasis on enforcing grazing plan.
	Juvenile/adult summer and winter habitat quality has decreased	See above	See above
	Temperature regimes between fluvial adult rearing and spawning areas have been modified	See above	See above
	Competition and hybridization with exotic species	Introduced brook trout	Assess feasibility of eradicating brook trout from the drainage
Squaw Creek	Competition, predation, and hybridization with exotic species	Introduced brook trout	Assess feasibility of eradicating brook trout from the drainage
Mill Creek	Competition, predation, and hybridization with exotic species	Introduced brook trout	Assess feasibility of eradicating brook trout from the drainage
Middle Little Lost River	Temperature regime in juvenile/adult summer rearing areas has increased	Habitat alteration resulting from grazing and channelization	1. Continue to implement grazing plan developed as part of consultation making revisions as necessary. 2. Evaluate effects of channelization and develop strategy to restore natural stream channel
	Juvenile/adult summer and winter habitat	See above	See above

Table 5. Assessment of factors adversely affecting the population and potential recovery actions.

Population	Critical Factors Adversely Affecting the Population	Cause of Factor Adversely Affecting the Population	Potential Actions to Remove or Reduce the Adverse Affect
	quality has decreased		
	Temperature regimes between juvenile rearing and fluvial adult rearing areas have been modified	See above	See above
	Temperature regimes between fluvial adult rearing and spawning areas have been modified	See above	See above
Lower Little Lost River	Temperature regime in juvenile/adult summer rearing areas has increased	Habitat alteration resulting from grazing, channelization, and dewatering.	Evaluate this stream reach and develop strategy to restore habitat conditions
	Food production in juvenile/adult summer and winter habitat has decreased	See above	See above
	Juvenile/adult summer and winter habitat quality has decreased	See above	See above
	Juvenile/adult summer and winter habitat quantity has decreased	See above	See above
	Temperature regimes between juvenile rearing and fluvial adult rearing areas have been modified	See above	See above
	Temperature regimes between fluvial adult rearing and spawning areas have been modified	See above	See above
	Mortality in juvenile/adult summer and winter habitat has increased	Entrainment through flood control project and other diversions	1. Inventory diversions 2. Evaluate rates of entrainment through diversions 3. Assess feasibility of reducing entrainment rates (e.g. – screening, etc.)

Table 6. Additional actions needed to protect populations that are not currently meeting recovery objectives.

Population	Potential Actions to Protect Populations
Badger Creek	1. Continue to implement grazing plan developed as part of consultation making revisions as necessary. 2. If barrier is removed, monitor lower portion of stream to detect invasion by brook trout. If brook trout are found to be invading the stream work to prevent the invasion. 3. As appropriate, protect and restore private lands through easements, exchanges, cost sharing, etc. 4. Evaluate effect of livestock grazing on spawning and egg incubation and adjust grazing strategy as appropriate
Williams Creek	1. Continue to implement grazing plan developed as part of consultation making revisions as necessary. 2. If barrier is removed, monitor lower portion of stream to detect invasion by brook trout. If brook trout are found to be invading the stream work to prevent the invasion.
Wet Creek	1. Evaluate effect of fishing (e.g. - illegal harvest, hooking mortality, etc.) on the population and implement any appropriate actions (e.g. - angler education, enforcement, revision of regulations). 2. As appropriate, protect and restore private lands through easements, exchanges, cost sharing, etc. 3. As interim protection measure, assess feasibility of installing fish barriers above upper limit of brook trout distribution.
Squaw Creek	1. Continue to implement grazing plan developed as part of consultation making revisions as necessary. 2. Evaluate effect of livestock grazing on spawning and egg incubation and adjust grazing strategy as appropriate 3. As interim protection measure, assess feasibility of installing fish barriers above upper limit of brook trout distribution.
Mill Creek	1. Continue to implement grazing plan developed as part of consultation making revisions as necessary. 2. Relocate Mill Creek Trailhead away from Mill Creek and rehabilitate the existing trailhead site. 3. Evaluate effect of livestock grazing on spawning and egg incubation and adjust grazing strategy as appropriate 4. As interim protection measure, assess feasibility of installing fish barriers above upper limit of brook trout distribution.
Middle Little Lost River	1. Evaluate effect of fishing (e.g. - illegal harvest, hooking mortality, etc.) on the population and implement any appropriate actions (e.g. - angler education, enforcement, revision of regulations). 2. As appropriate, protect and restore private lands through easements, exchanges, cost sharing, etc.
Lower Little Lost River	1. Evaluate effect of fishing (e.g. - illegal harvest, hooking mortality, etc.) on the population and implement any appropriate actions (e.g. - angler education, enforcement, revision of regulations). 2. As appropriate, protect and restore private lands through easements, exchanges, cost sharing, etc.

Table 7. Protection and Recovery Actions.

Population	Potential Actions to Protect or Recover the Population	Is the action biologically, economically, and socially feasible?	Discussion	Recommended Action
Badger Creek	1. Develop management strategy to reduce sediment levels on National Forest and private lands	Yes		Yes
	2. Provide for upstream fish passage at diversion			
	3. Assess feasibility of providing minimum flow between diversion and Little Lost River	Yes		Yes
	4. Continue to implement grazing plan developed as part of consultation making revisions as necessary.	Yes		Yes
	5. If barrier is removed, monitor lower portion of stream to detect invasion by brook trout. If brook trout are found to be invading the stream work to prevent the invasion.	Yes		Yes
	6. As appropriate, protect and restore private lands through easements, exchanges, cost sharing, etc.	Yes		Yes
	7. Evaluate effect of livestock grazing on spawning and egg incubation and adjust grazing strategy as appropriate	Yes		Yes

Table 7. Protection and Recovery Actions.

Population	Potential Actions to Protect or Recover the Population	Is the action biologically, economically, and socially feasible?	Discussion	Recommended Action
Williams Creek	1. Evaluate feasibility of reconnecting Williams Creek to Little Lost River	Yes		Yes
	2. Evaluate feasibility of providing minimum flow between diversions and Little Lost River	Yes		Yes
	3. Continue to implement grazing plan developed as part of consultation making revisions as necessary.	Yes		Yes
	4. If barrier is removed, monitor lower portion of stream to detect invasion by brook trout. If brook trout are found to be invading the stream work to prevent the invasion.	Yes		Yes
Wet Creek	1. Develop and implement management strategy to reduce sediment levels in spawning areas	Yes		Yes
	2. Continue to implement grazing plan developed as part of consultation making revisions as necessary. On Forest lands, place additional emphasis on enforcing grazing plan.	Yes		Yes
	3. Assess feasibility of eradicating brook trout from the drainage			
	4. Evaluate effect of fishing (e.g. - illegal harvest, hooking mortality, etc.) on the population and implement any appropriate actions (e.g. - angler education, enforcement, revision of regulations).	Yes		Yes
	5. As appropriate, protect and restore private lands through easements, exchanges, cost sharing, etc.	Yes		Yes
	6. As interim protection measure, assess feasibility of			

Table 7. Protection and Recovery Actions.

Population	Potential Actions to Protect or Recover the Population	Is the action biologically, economically, and socially feasible?	Discussion	Recommended Action
	installing fish barriers above upper limit of brook trout distribution.	Yes		Yes
		Yes		Yes
Warm Creek	1. Monitor lower portion of stream to detect invasion by brook trout. If brook trout are found to be invading the stream work to prevent the invasion.	Yes		Yes
	2. Evaluate effect of livestock grazing on spawning and egg incubation and adjust grazing strategy as appropriate	Yes		Yes
Squaw Creek	1. Assess feasibility of eradicating brook trout from the drainage	Yes		Yes
	2. Continue to implement grazing plan developed as part of consultation making revisions as necessary.	Yes		Yes
	3. Evaluate effect of livestock grazing on spawning and egg incubation and adjust grazing strategy as appropriate	Yes		Yes
	4. As interim protection measure, assess feasibility of installing fish barriers above upper limit of brook trout distribution.	Yes		Yes

Table 7. Protection and Recovery Actions.

Population	Potential Actions to Protect or Recover the Population	Is the action biologically, economically, and socially feasible?	Discussion	Recommended Action
Mill Creek	1. Assess feasibility of eradicating brook trout from the drainage	Yes		Yes
	2. Continue to implement grazing plan developed as part of consultation making revisions as necessary.	Yes		Yes
	3. Relocate Mill Creek Trailhead away from Mill Creek and rehabilitate the existing trailhead site.	Yes		Yes
	4. Evaluate effect of livestock grazing on spawning and egg incubation and adjust grazing strategy as appropriate			
	5. As interim protection measure, assess feasibility of installing fish barriers above upper limit of brook trout distribution.	Yes		Yes
		Yes		Yes
Iron Creek	1. Continue to implement grazing plan developed as part of consultation making revisions as necessary.	Yes		Yes
	2. Monitor lower portion of stream to detect invasion by brook trout. If brook trout are found to be invading the stream work to prevent the invasion.	Yes		Yes
	3. Evaluate fish passage through culverts associated with Forest Service Road #104 on Jackson Creek and Hawley Creek and modify/replace as necessary to provide for fish passage.	Yes		Yes

Table 7. Protection and Recovery Actions.

Population	Potential Actions to Protect or Recover the Population	Is the action biologically, economically, and socially feasible?	Discussion	Recommended Action
	4. Reduce sediment from roads and trails. 5. Evaluate effect of livestock grazing on spawning and egg incubation and adjust grazing strategy as appropriate	Yes Yes		Yes Yes
Smithie Fork Creek	1. Continue to implement grazing plan developed as part of consultation making revisions as necessary. 2. Monitor lower portion of stream to detect invasion by brook trout. If brook trout are found to be invading the stream work to prevent the invasion. 3. Evaluate effect of fishing (e.g. - illegal harvest, hooking mortality, etc.) on the population and implement any appropriate actions (e.g. - angler education, enforcement, revision of regulations). 4. Evaluate effect of livestock grazing on spawning and egg incubation and adjust grazing strategy as appropriate	Yes Yes Yes Yes		Yes Yes Yes Yes
Upper Little Lost River	1. Continue to implement grazing plan developed as part of consultation making revisions as necessary.	Yes		Yes

Table 7. Protection and Recovery Actions.

Population	Potential Actions to Protect or Recover the Population	Is the action biologically, economically, and socially feasible?	Discussion	Recommended Action
	2. Monitor lower portion of stream to detect invasion by brook trout. If brook trout are found to be invading the stream work to prevent the invasion.	Yes		Yes
	3. Evaluate potential of Moonshine Creek to support bull trout. If it is suitable, replace culvert to provide for fish passage and introduce bull trout into Moonshine Creek.	Yes		Yes
	4. Evaluate fish passage through two culverts associated with Forest Service Road #101 on the Little Lost River and modify/replace as necessary to provide for fish passage.			
	5. Evaluate effect of fishing (e.g. - illegal harvest, hooking mortality, etc.) on the population and implement any appropriate actions (e.g. - angler education, enforcement, revision of regulations).	Yes		Yes
	6. Evaluate effect of livestock grazing on spawning and egg incubation and adjust grazing strategy as appropriate	Yes		Yes
		Yes		Yes

Table 7. Protection and Recovery Actions.

Population	Potential Actions to Protect or Recover the Population	Is the action biologically, economically, and socially feasible?	Discussion	Recommended Action
Middle Little Lost River	1. Continue to implement grazing plan developed as part of consultation making revisions as necessary.	Yes		Yes
	2. Evaluate effects of channelization and develop strategy to restore natural stream channel	Yes		Yes
	3. Evaluate effect of fishing (e.g. - illegal harvest, hooking mortality, etc.) on the population and implement any appropriate actions (e.g. - angler education, enforcement, revision of regulations).	Yes		Yes
	4. As appropriate, protect and restore private lands through easements, exchanges, cost sharing, etc.	Yes		Yes

Table 8. Protection and Recovery Plan.

Population	Recommended Action	Responsible Organization(s)	Target Date
Badger Creek	1. Develop management strategy to reduce sediment levels on National Forest and private lands	USFS, NRCS, USFWS	
	2. Provide for upstream fish passage at diversion	NRCS, USFWS	
	3. Assess feasibility of providing minimum flow between diversion and Little Lost River	NRCS, USFWS	
	4. Continue to implement grazing plan developed as part of consultation making revisions as necessary.	USFS, BLM	
	5. If barrier is removed, monitor lower portion of stream to detect invasion by brook trout. If brook trout are found to be invading the stream work to prevent the invasion.	BLM, IDFG	
	6. As appropriate, protect and restore private lands through easements, exchanges, cost sharing, etc.	USFS, NRCS	
	7. Evaluate effect of livestock grazing on spawning and egg incubation and adjust grazing strategy as appropriate	USFS, USFWS, IDFG	
Williams Creek	1. Evaluate feasibility of reconnecting Williams Creek to Little Lost River	BLM, NRCS, USFWS	
	2. Evaluate feasibility of providing minimum flow between diversions and Little Lost River	BLM, NRCS, USFWS	
	3. Continue to implement grazing plan developed as part of consultation making revisions as necessary.	USFS, BLM	
	4. If barrier is removed, monitor lower portion of stream to detect invasion by brook trout. If brook trout are found to be invading the stream work to prevent the invasion.	BLM, IDFG	
Wet Creek	1. Develop and implement management strategy to reduce sediment levels in spawning areas	USFS	

Table 8. Protection and Recovery Plan.

Population	Recommended Action	Responsible Organization(s)	Target Date
	2. Continue to implement grazing plan developed as part of consultation making revisions as necessary. On Forest lands, place additional emphasis on enforcing grazing plan.	USFS, BLM	
	3. Assess feasibility of eradicating brook trout from the drainage	IDFG, USFWS, USFS, BLM	
	4. Evaluate effect of fishing (e.g. - illegal harvest, hooking mortality, etc.) on the population and implement any appropriate actions (e.g. - angler education, enforcement, revision of regulations).	IDFG, USFWS	
	5. As appropriate, protect and restore private lands through easements, exchanges, cost sharing, etc.	NRCS, USFWS, USFS, BLM	
	6. As interim protection measure, assess feasibility of installing fish barriers above upper limit of brook trout distribution.	IDFG, USFWS, USFS	
Warm Creek	1. Monitor lower portion of stream to detect invasion by brook trout. If brook trout are found to be invading the stream work to prevent the invasion.	IDFG, USFS	
	2. Evaluate effect of livestock grazing on spawning and egg incubation and adjust grazing strategy as appropriate	USFS, USFWS, IDFG	
Squaw Creek	1. Assess feasibility of eradicating brook trout from the drainage	IDFG, USFWS, USFS	
	2. Continue to implement grazing plan developed as part of consultation making revisions as necessary.	USFS	
	3. Evaluate effect of livestock grazing on spawning and egg incubation and adjust grazing strategy as appropriate	USFS, USFWS, IDFG	
	4. As interim protection measure, assess feasibility of installing fish barriers above upper limit of brook trout distribution.	IDFG, USFWS, USFS	
Mill Creek	1. Assess feasibility of eradicating brook trout from the drainage	IDFG, USFWS, USFS	

Table 8. Protection and Recovery Plan.

Population	Recommended Action	Responsible Organization(s)	Target Date
	2. Continue to implement grazing plan developed as part of consultation making revisions as necessary.	USFS	
	3. Relocate Mill Creek Trailhead away from Mill Creek and rehabilitate the existing trailhead site.	USFS	
	4. Evaluate effect of livestock grazing on spawning and egg incubation and adjust grazing strategy as appropriate	USFS, USFWS, IDFG	
	5. As interim protection measure, assess feasibility of installing fish barriers above upper limit of brook trout distribution.	IDFG, USFWS, USFS	
Iron Creek	1. Continue to implement grazing plan developed as part of consultation making revisions as necessary.	USFS	
	2. Monitor lower portion of stream to detect invasion by brook trout. If brook trout are found to be invading the stream work to prevent the invasion.	IDFG, USFS	
	3. Evaluate fish passage through culverts associated with Forest Service Road #104 on Jackson Creek and Hawley Creek and modify/replace as necessary to provide for fish passage.	USFS	
	4. Reduce sediment from roads and trails.	USFS	
	5. Evaluate effect of livestock grazing on spawning and egg incubation and adjust grazing strategy as appropriate	USFS, USFWS, IDFG	
Timber Creek	1. Continue to implement grazing plan developed as part of consultation making revisions as necessary.	USFS	
	2. Monitor lower portion of stream to detect invasion by brook trout. If brook trout are found to be invading the stream work to prevent the invasion.	USFS, IDFG	
	3. Remove artificial barrier on lower Camp Creek	USFS	

Table 8. Protection and Recovery Plan.

Population	Recommended Action	Responsible Organization(s)	Target Date
	4. Reduce sediment from roads and trails.	USFS	
	5. Evaluate fish passage through a culvert associated with Forest Service Road #105 on Timber Creek and a culvert associated with Forest Service Road #460 on Redrock Creek and modify/replace as necessary to provide for fish passage.	USFS	
	6. Evaluate effect of fishing (e.g. - illegal harvest, hooking mortality, etc.) on the population and implement any appropriate actions (e.g. - angler education, enforcement, revision of regulations).	IDFG, USFWS	
	7. Evaluate effect of livestock grazing on spawning and egg incubation and adjust grazing strategy as appropriate	USFS, USFWS, IDFG	
Smithie Fork Creek	1. Continue to implement grazing plan developed as part of consultation making revisions as necessary.	USFS	
	2. Monitor lower portion of stream to detect invasion by brook trout. If brook trout are found to be invading the stream work to prevent the invasion.	USFS, IDFG	
	3. Evaluate effect of fishing (e.g. - illegal harvest, hooking mortality, etc.) on the population and implement any appropriate actions (e.g. - angler education, enforcement, revision of regulations).	IDFG, USFWS	
	4. Evaluate effect of livestock grazing on spawning and egg incubation and adjust grazing strategy as appropriate	USFS, USFWS, IDFG	
Upper Little Lost River	1. Continue to implement grazing plan developed as part of consultation making revisions as necessary.	USFS	
	2. Monitor lower portion of stream to detect invasion by brook trout. If brook trout are found to be invading the stream work to prevent the	USFS, IDFG	

Table 8. Protection and Recovery Plan.

Population	Recommended Action	Responsible Organization(s)	Target Date
	invasion.		
	3. Evaluate potential of Moonshine Creek to support bull trout. If it is suitable, replace culvert to provide for fish passage and introduce bull trout into Moonshine Creek.	USFS	
	4. Evaluate fish passage through two culverts associated with Forest Service Road #101 on the Little Lost River and modify/replace as necessary to provide for fish passage.	USFS	
	5. Evaluate effect of fishing (e.g. - illegal harvest, hooking mortality, etc.) on the population and implement any appropriate actions (e.g. - angler education, enforcement, revision of regulations).	IDFG, USFWS	
	6. Evaluate effect of livestock grazing on spawning and egg incubation and adjust grazing strategy as appropriate	USFS, IDFG, USFWS	
Middle Little Lost River	1. Continue to implement grazing plan developed as part of consultation making revisions as necessary.	BLM	
	2. Evaluate effects of channelization and develop strategy to restore natural stream channel	BLM	
	3. Evaluate effect of fishing (e.g. - illegal harvest, hooking mortality, etc.) on the population and implement any appropriate actions (e.g. - angler education, enforcement, revision of regulations).	IDFG, USFWS	
	4. As appropriate, protect and restore private lands through easements, exchanges, cost sharing, etc.	NRCS, USFWS, BLM	
Lower Little Lost River	1. Evaluate this stream reach and develop strategy to restore habitat conditions	USFWS, NRCS	
	2. Inventory diversions	NRCS, BLM	

Table 8. Protection and Recovery Plan.

Population	Recommended Action	Responsible Organization(s)	Target Date
	3. Evaluate rates of entrainment through diversions	IDFG, BLM, NRCS, USFWS	
	4. Assess feasibility of reducing entrainment rates (e.g. – screening, etc.)	IDFG, BLM, NRCS, USFWS	
	5. Evaluate effect of fishing (e.g. - illegal harvest, hooking mortality, etc.) on the population and implement any appropriate actions (e.g. - angler education, enforcement, revision of regulations).	IDFG, USFWS	
	6. As appropriate, protect and restore private lands through easements, exchanges, cost sharing, etc.	NRCS, USFWS, BLM	

Appendix C: Estimated abundance of adult-size bull trout in each local population and minimum abundance for recovery.

Local population	Estimated current abundance	Recovered abundance
Badger Creek	300	300
Williams Creek	100	100
Wet Creek	100	600
Warm Creek	50	50
Squaw Creek	200	200
Mill Creek	100	100
Iron Creek	100	100
Timber Creek	200	200
Smithie Fork Creek	1,300	1,300
Upper Little Lost River	3,800	3,800
Total	6,250	6,750

APPENDIX D: List of Chapters